

A HISTORY OF ROADS
FROM
ANCIENT TIMES TO THE MOTOR AGE

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PREFACE

The writer has attempted in this thesis to compile in a single volume the history of roads from ancient times to the motor age. With the introduction of the motor vehicle such a drastic change in design and methods of construction of highways took place that the field of highway engineering was completely revolutionized. Prior to the motor age, the tempo of life was in tune with the fastest rate at which a horse could travel, and the given amount of articles of trade depended upon the ability of the beasts of burden to transport limited loads. Considering the total lack of mechanical equipment, the highway engineer of the past displayed considerable foresight and ingenuity in solving the problem of transport and his knowledge of the principles of engineering are worthy of utmost respect when we consider that hand labor was the only means at his command with which to overcome the same tremendous obstacles of nature which the modern engineer conquers with the assistance of mechanized giants.

Volumes have been written on the subject of Roman roads, creating the impression that the Romans were the originators of road construction, but well built paved roads existed throughout the ancient world several thousand years before Rome crept out of the Pontine Marshes to sit on her Seven Hills and rule the world. The curiosity of historians even seems to have been dimmed by this belief in the originality of the

Romans as inventors of road building, yet, the existence of magnificent civilizations long buried under stratified debris and the tremendous volume of trade necessary to develop these civilizations, presupposes the existence of well built roads to carry the trade so essential to the well-being of these ancient peoples.

As far as is known to the writer, this is the first attempt to cover the subject of roads in its various stages and settings from most ancient times, giving due credit to each civilization as it strode across the stage of history. All of the information contained in this thesis has been obtained from the Carnegie Library of Atlanta and the Emory University Library. The writer especially wishes to express his gratitude to the Emory University Library for the unlimited privileges granted him and the courtesies extended in carrying on his research. Full acknowledgment is also given to Doctor F. C. Snow and Professor J. H. Lucas whose unfailing cooperation and constant interest in the subject has made the work a pleasure.

It is realized, of course, that the scope of the subject covered in this thesis is introductory only when one considers that whole civilizations and thousands of years are involved, but with Tai T'ung, "Were I to await perfection, my book would never be finished."

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"If you wish to know whether society is stagnant, religion a dead formality, you may learn something by going into universities and libraries; something also by the work that is doing on cathedrals and churches, or in them; but quite as much by looking at the roads. For if there is any motion in society, the Road, which is the symbol of motion, will indicate the fact. When there is activity or enlargement, or a liberizing spirit of any kind, then there is intercourse and travel, and these require roads. So if there is any kind of advancement going on, if new ideas are abroad and new hopes rising, then you will see it by the roads that are building. Nothing makes an inroad without making a road. All creative action, whether in government, industry, thought or religion, creates roads."

Horace Bushnell

THE ROAD MAN CAME

"Musing,
I shut my eyes
And think of the road I have come."

Li Hai-ku

THE ROAD MAN CAME

Man has travelled the face of the earth throughout untold milleniums and in so doing has used that which he first of all things created, for, "In the beginning was the road." A roof to shelter him from the storms, a fire to warm his chilled body, a weapon to guard his life, a word to speak to friend or foe, a seed to plant for bodily sustenance, an animal to bear his burdens; all these were creations of his growing mentality which grasped and solved the problems of life as he walked his roads and observed that which went on about him.

The road has been with us as long as there has been a living thing to trod and crawl the earth. Man, when he first went in search of food and water, established a path to be followed by recurrent waves of civilizations from the dim past, stumbling and halting at times, but ever moving forward until today we stand in his place and ponder the way which he came; trails worn deep by the countless feet of animals lead today as always to feeding grounds and watering places; reptiles even, such as boa constrictors, are known to have definite routes which they travel, tunnelled through the almost impenetrable denseness of jungle growth. These trails, humble though they be, are the forerunners of our modern high-speed highways, for in many cases roads today may follow in whole or in part these paths established by primitive man and by animals whose instincts led them to choose the easiest gradients and to cross mountains by the likeliest passes.

The ability of animals to select the best locations over which to travel is excellently demonstrated here in the United States by the buffalo, over whose trails, to a large extent, the tides of a restless and adventurous people flowed to conquer the wilderness and create a new and powerful nation. Hulbert states that:

"The buffalo, because of his sagacious selection of the most sure and most direct courses, has influenced the routes of trade and travel of the white race as much, possibly, as he influenced the course of the red men in earlier days. There is great truth in Thomas Benton's figure when he said that the buffalo blazed the way of the railways to the Pacific. That sagacious animal undoubtedly 'blazed' with his hoofs on the surface of the earth - the course of many of our roads, canals and railways. That he found the points of least resistance across our great mountain ranges there can be little doubt. It is certain that he discovered Cumberland Gap and his route through that pass in the mountains has been accepted as one of the most important on the continent. It is also obvious that the buffalo found the course from Atlantic Waters to the head of the Great Kanawha, and that he opened a way from the Potomac to the Ohio.

"In a host of instances our highways and railroads follow for many miles the general line of the routes of the buffalo and Indian on the high ground. This is particularly true of our roads of secondary importance, county roads, which in hundreds of instances follow the alignment of a pioneer road which was laid out on an Indian trail."

Man at first, of course, devoured his food at the site of the kill, but having established a home in a cave, he carried it there on his back, or if the burden proved too great, he dragged it, thus widening his road from a mere footpath. Later on he learned that his burden could be transported with less effort by laying it across the branches of a tree and dragging it along in this manner, and later still he probably improved upon this method by constructing a rude sled of limbs and cross-pieces. Dragging the burden in this manner - food for his family

or wood for his fire - brought about the first step in road construction and maintenance, for rocks and other obstructions that could readily be sidestepped in walking caused delays and extra effort to readjust the load, to lift it back upon his crude sled. This soon taught him to keep his paths clear of obstructions.

Domestication of animals relieved man of the burden of transport so that he had greater opportunity to observe and to evolve new ideas; not only that, it opened up new territory from which to obtain things which he did not possess. More important than this, however, it made him master over other living creatures and the owner of tangible property, gave him self assurance and forthwith propelled him forward on the long, uphill climb to civilization.

One of the most vital of all things created by man at any time throughout his entire history is the wheel. Progenitor of every mechanical invention we have today, it has probably had a more potent effect upon our present civilization than any other one factor. More than ever before are we dependent upon this humble invention, for we regulate our lives by the wheels in watches; we travel the earth, the sea, the sky by means of wheels; we harvest and process our food, weave our clothing, light and heat our homes, print our books and papers, manufacture all manner of goods; all by the use of wheels. Take the wheel and its principle of motion away from us and we revert to the semi-primitive. Varied and intricate are the uses to which the wheel has been adapted, but one point is ineluctable-

to the road was the wheel born and to the road it remains. Remove it from the road or the railroad and every other wheel in use will stop in harmony.

How, when or where the wheel was invented is a matter of pure conjecture. Inscriptions and archeological finds prove that it was known as far back as the 4th millenium B.C., but civilization was already far advanced at this stage. Childe states that:

"Well before the end of the 4th millenium B.C., wheeled vehicles were in use from the Indus to the coasts of the Mediterranean. Very soon they reached Crete, but in Egypt the device was not adopted till it was imposed by the Hyksos from Asia about 1700 B.C. There is no question that the invention was infused. Early in the 3rd millenium, models from Crete, Assyria, Babylonia, Turkestan and India all exhibit divergences in the construction of the vehicles. The idea must have been implanted long enough in several centres for local differentiation to have taken place."

A rounded stone rolling down hill or the ease with which a log could be rolled along the ground may have suggested to primitive man the idea of placing rollers under his load. Cutting away the excess middle portion of these rollers, thus lifting the load itself off of the ground and thereby reducing friction, was the next probable step forward, and this in turn led to the construction of large, solid, cumbersome wheels with their proportionately small axles, all in one piece. The real step forward, however, was when the wheel was made to rotate about the axle rather than with it. The idea of spokes is thought to have originated from the practice of inserting a lever in a hole through the solid wheel in order to assist in the movement of heavy loads and the obvious advantage of having several such holes may have suggested eventually the cutting away of most of

the excess wood, resulting finally in the beautifully and trimly built chariots of which specimens are still extant.

The different stages through which man passed to reach the present is an ever recurring perplexity. Two centuries ago all but a few sceptics were positive that the age of man and the whole story of his civilization was definitely established by the history of one people as set forth in the Bible. Rome, Carthage, Greece were real to us because we had tangible evidence that they had existed; Egypt, the taskmaster, was a reality too, but her massive monuments, undaunted by Time, were unexplainable until the Rosetta Stone unlocked the door to her antiquity. Nineveh and Babylon were fabulous beyond belief and mythical almost except as they served the purpose of being the source of all abominations. Yet withal, we find these same semimyths to be truths brought to light by patient and scientific research. Back of Egypt, Assyria and Babylon, however, was Akkad, Sumer, Elam and India even to the 4th and 5th millenium B.C.

Ancient though these discoveries may be, a very recent find propels the story of man backwards another 4,000 years. This discovery, buried in ice presumably for 10,000 years, throws an entirely new light on man's antiquity. Harold O. Whitnall, Professor of Geology at Colgate University, has so graphically described this find that it is quoted herewith:

"Stretching across Northern Siberia is a freak of nature, a strip known as the area of eternal frost. At the foot of the Altai Mountains, Professor Gryaznov, of the Soviet Academy of Science on Eternal Frost, dug down 50 feet into this natural ice-box which never defrosts, and broke into a chamber built of logs and planks, hewn by Bronze-Age axes.

"This chamber proved to be a stable which Professor Gryaznov believes was built about 10,000 years ago and his electric flashlight revealed the ghosts of ten sorrel horses.

"They stood there all saddled, bridled and ready for that last journey which their masters never called upon them to take. They were not skeletons, but flesh and blood horses, with every hair of their coats intact, even their eyes, the blood in their veins and the half-digested remains of their last meal, still in their stomachs.

"For a hundred centuries these horses, embalmed in the eternal frost, like marble statues, have stood with their frozen eyes, looking for the summons that never came."

Regarding the owners of these horses, Professor Whitnall goes on to say that:

"The striking features of these men is that, judged by the equipment of their horses, they belonged to a race of high grade artists and artisans. The leather of their saddles is still splendidly preserved and even the carved wood, when warmed up, gave off a resinous odor. The wood like the leather of the saddles and also the bridles were handsomely inlaid with gold and tinfoil, only slightly tarnished, after their long burial. Even the felt coverlets retained their color design, such is the perfect preservative power of frost and darkness."

The road has been so inextricably bound up with our very existence that we think no more of it than we do of any member of our personal body - until we lose it. Along these arteries of existence flowed everything that made us men, commerce, knowledge and religion. When these arteries cease to function the lifeblood of civilization no longer flows, and the parts so affected wither and die as much so as do members of our bodies no longer nourished by the blood in our own arteries. What matter it that salt, or meat, or grain, or clothing be plentiful in one section and abject misery exist in another if there be no road between them to effect a transfer from those who have to those who have not. Industry without roads over which

to draw raw materials and expel finished products would become so emaciated that it would ere long gasp out its last breath to the faltering tones of its own death song. Knowledge is a fatuity if it is not disseminated; and without roads it would be like a beautiful bird in a gilded cage, fluffing his gorgeous plumage in solitude and eking out a trite expression of song only to prove to himself that his ears could still hear his own voice. Religion would not be even a dead formality, for it would never have lived since it needs must ceaselessly walk the roads of the world to keep the spark of spirituality a bright flame by which to warm our souls.

No one thing has reflected the true image of man through his various stages of advancement as has the road. Oldest, humblest and most subtle of all his accomplishments, it has carried all the joy and sorrow, love and hatred, knowledge and superstition, that man has experienced. The whole history of man has been written large upon the roads of the world, but Time, the destroyer, has left us no key to the secret. Belloc has aptly said that:

"More than rivers and more than mountain chains, roads have moulded the political groups of men. The Alps with a mule-track across them are less of a barrier than fifteen miles of forest or rough land separating one from that track."

EGYPTIAN ROADS

"I follow my angel to the sunset, the sunset,
Over the beautiful roads of the West;
I pass to my God through the sunset, the sunset,
There will my heart have rest."

Ancient Egyptian Song

EGYPTIAN ROADS

Egypt, the gift of the Nile, reborn each year from its life-giving waters, can never be thought of except in connection with the Nile. No river in the world has so completely influenced a civilization as this one which fed, clothed, bathed, and carried a people for thousands of years. Everything Egyptian is thought of in connection with the river.

Granted that it alone did provide the means of a physical existence, no claims can be justified that it alone provided the highly civilized cultural growth as evidenced by magnificent palaces, temples and tombs. All of the tangible evidence of this culture came not from the river, but from the mountains and the deserts nearby and from the land beyond.

The Nile as an avenue of transport has not only overshadowed, but has nearly obliterated the thought that Egypt had roads, that she built high-type roads and used them throughout her entire history. How else could massive statues of granite, weighing nearly 1000 tons, be moved over great distances from the mountains on one side of the river to the plateau on the other side; sculptured not at the site of erection, but at the quarries from which the stone was extracted? How else could thousands of blocks of limestone, each averaging two and one half tons in weight, and used in one pyramid alone, be transported? Of what use were the thousands of horses and chariots scattered throughout the land without roads upon which to travel, roads which would be serviceable during the periods of

inundation as well as during periods of extreme low water?

Roads in Egypt are as ancient as her known history. One of the important stages in the very remote history of Egypt was the fixing of clans in 'nomes' or districts. Each nome comprised a territory and a capital. The town, or 'nut', was built at a cross-road, as its word-sign signifies, and was surrounded by a circular wall for defense, where all, natives as well as travelers, took refuge at night. Each large village possessed two roads, which ran through it from side to side and crossed in the middle at right angles.

Frequent and commonplace reference is made to roads in the numerous historical and religious inscriptions preserved on both stone and papyrus. One of the patron spirits of the West, as related in the religious texts of the Divine Kingdoms of the Delta, was Wolf Upuat - "He who opens the roads." On the walls of the great temple of Horus at Edfu is a very long narrative relating the legend of Ra which tells how Isis, unable to secure the information desired, made a sacred snake and set it in the god's path. Ra was bitten, and groaning with pain, he summoned the Council of the Gods and told them that "When I was going upon the roads, to contemplate what I have created, travelling over the Two Lands (Upper and Lower Egypt) which I made, something, I know not what, hurt me." At another time when Ra, attempting to stop Hathor from slaughtering men right and left, and finding that appeal was useless, tried another course - "He said: 'Call on my behalf messengers agile and swift, who go like the wind.' When these messengers were in

straightway brought to him, the Majesty of the god said: 'Let them run to Elphantine and bring me mandragora in plenty'." Now if the river were the most important means of traffic and if the roads were unimportant and consequently unimproved, why should the god dispatch messengers to run to Elphantine on most urgent business unless the roads were fit to travel over on business for a god. In the Festal Songs of Isis and Nephthys it is stated that "I travelled about on the roads wandering backwards and forwards in my search for my brother." The Hymn of Aton states that "Every highway is open because thou hast dawned," and

"Thou makest the beauty of form, through thyself alone.
Cities, towns and settlements,
On highway or on river,
All eyes see thee before them,
For thou art Aton of the day over the earth."

It appears from extant inscriptions that roads were considered quite important to the Nilotic civilization because they were foremost in the minds of the Pharaoh and the fellahin alike upon the return to peace and order after a period of war and famine. Ramses III, having defeated his enemies, depicts the peace that settled down upon the land in these words:

"I made the woman of Egypt to go with uncovered ears
to the place she desired, for no stranger nor any
one upon the road molested her."

In the Song of Triumph, found in Merenptah's funerary temple, the long-harried fellahin joyfully expresses his feelings of security thus:

"Come far out upon the roads.
There is no fear in the heart of men."

In the Hymn of Osiris it is recited that:

"Strength has made a place for itself; abundance is established through his laws. The roads are free and the ways are open."

The oldest paved road in history of which we have an authentic record was built by Khufu about 3000 B.C. (Petrie sets the date about 4000 B.C.), during the IVth Dynasty, in order to transport stones from the quarries on the east side of the Nile to the plateau on the opposite side upon which the pyramid was constructed. In describing the pyramid of Khufu and its construction, Herodotus places particular emphasis on the paved road, stating that:

"some, accordingly were appointed to draw stones from the quarries in the Arabian mountains down to the Nile, others he ordered to receive the stones when transported in vessels across the river, and to drag them to the mountain called Libyan. And they worked to the number of a hundred thousand men at a time, each party during three months. The time during which the people were thus harassed by toil lasted ten years on the road which they constructed, along which they drew the stones, a work, in my opinion, not much less than the pyramid: for its length is five stades (3033 feet), and its width ten orgyae (60 feet), and its height, where it is highest, eight orgyae (48 feet); and it is of polished stone with figures carved on it."

Petrie states that there are several causeways beside the main one, still visible on the desert, and they must have been closely packed with working gangs to get up the thousand blocks every day during the working season.

Petrie has estimated that the pyramid of Khufu contains some 2,300,000 blocks of stone, each weighing on the average two and one half tons, and believes that the length of time and the amount of labor employed as stated by Herodotus is so entirely reasonable for the execution of such work, that we cannot hesitate to accept the statement that 100,000 men were

employed for three months at a time during the inundation for twenty years. The advancement in architecture of this period required finer stone and an alabaster quarry was opened about ten miles from the Nile, behind Tell el Amarna, and there Khufu began quarrying operations by first cutting a wide, gently-sloping road.

From the temple of Khafra, successor to Khufu and builder of the second largest pyramid, a causeway led down a line of the rock plateau, where a gradual and easy slope could be laid out. According to Petrie, it is evident that this is a road of convenience, made exactly where it could be laid out with the best gradient. It was doubtless the road up which all the material was brought for the building of the pyramid and the temple, like the roads belonging to the other pyramids. It was paved with fine stone, recessed into the rock bed. Both the pyramid temple and the valley temple which are connected by this road are oriented square to the points of the compass; but the road is askew for reasons of its construction.

The Nile River has from the beginning required that its flow be controlled otherwise when it overflowed it submerged the valley destroying everything in its path, and when it was low the whole country was plunged in great distress. To protect the country from either a shortage or excess of water, mighty dykes were constructed parallel to the bank while others ran perpendicular from the river to the Libyan and Arabian hills. The dykes not only served to confine the water, but also served as highways during the inundation so that travel by land was

uninterrupted.

Budge states that before centralization of government, the men in each district or 'nome' protected the part of the bank of the Nile that belonged to them, and made and maintained their own canals, and the high causeways, which connected the towns and villages during the period of the flood, and served as roads. The more important ones were built of hewn stone, while brick and stone sufficed for the others. Menes, who founded the 1st Dynasty, is said to have built those which protected the Nome of Memphis.

The whole of Egypt was consequently well equipped for travel on land from the very beginning of its known history, regardless of the condition of the river. King and peasant travelled these roads, commerce and religion used them, and marching armies, foreign as well as Egyptian, traversed the entire length of the country from the Delta on into Nubia. With the introduction of the horse and the chariot by the Hyksos, or Shepherd Kings, roads became increasingly important since this mode of travel was highly esteemed by the Egyptians. It was reported that in Thebes alone were stabled 20,000 chariots, and Diodorus relates that in his time the foundations of 100 stables, each capable of holding 200 horses, were still to be seen on the western bank of the river between Memphis and Thebes.

Weigall states that on the eastern mainland opposite Elphantine was a great Swanu or market (present-day Aswan) to which came negroes from the upper reaches of the river by the valley road which avoids the rocks of the cataract, to meet and trade with the inhabitants of Elphantine. A continuation of this route

from Elephantine to Arthet was the one probably opened by Herkhuf about 2500 B.C. (3447 - 3443 B.C. according to Petrie) when he was sent with his father by the Pharaoh "to explore a road to the country of Aam (Lower Nubia)." Weigall informs us that:

"Traces of this highroad still remain after 4400 years. At the top of the hill opposite Elephantine one will suddenly come upon a paved causeway which sweeps over the sand to the rocky summit. Rough flat blocks of sandstone form the paving, and **these** are only here and there overwhelmed by the drifting sand, though it is evident that the road has been entirely buried at the point where it approaches the water.

"Mounting to the hill-top, the causeway is seen to pass within a few yards of a great boulder, on the side of which are several inscriptions recording the coming of various officials of the empire - tax collectors, superintendents of the Nubian gold mines, and so on. It is evident from this that the road was used for many a long year after Herkhuf. For a short distance one may follow the paved road as it passes southward and westward, but presently it tops a ridge of rock and sand and so descends into and is lost amidst the wide undulating desert."

"The road descends to the river at Tomas near Derr. To the southwest the second portion of the highway, leading on to Aam, may be followed, but the point at which it descends again to the river has not been identified, though one may safely say that the terminus lay between Abu Simbel and the Second Cataract."

Along this road marched Egyptian troops on their way to conquer Sudan as inscriptions on the rock prove, and later we find this situation reversed when the people of the Sudan marched on Egypt and conquered it. The Greeks and the Romans came this way, the latter in haste to join Petronius in his pursuit of the one-eyed queen Kandake and her flying Ethiopians. Saladin's troops routing out Christianity from Nubia, the armies of Ibrahim Pasha driving before them the barbaric Mamelukes, Der-vishes marching on Egypt only to be defeated by an Egyptian-English force, all of these travelled this same highroad.

Petrie states that everywhere that great weights had to be

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moved to or from the river or canal, carefully graded roads of solid construction were built. Each pyramid had roads to take the blocks of stone up to it; and probably a dozen roads were required for the large pyramids which had to be supplied with 1000 blocks each day of the working season. Dragging colossi into place required carefully made roads. In all of the quarries we find evidence of well made roads, strong enough to prevent the tremendous weights from sinking into the embankment, smooth enough to prevent breakage of such slender shafts as the two obelisks of Queen Hatshepsut - each one being 97.5 feet long and weighing 350 tons according to Breasted, and with an easy gradient to facilitate the movement and balancing of enormous statues such as that of Ramses II which weighs nearly 1000 tons.

An unfinished obelisk of tremendous size still lies in the quarry of Aswan. It is undetached from its bed, but is otherwise separated from the surrounding rock by a trench 2.5 feet broad. This shaft, which was abandoned because of flaws, is 137 feet long, 13.8 feet square at the base and 8.2 feet square at the foot of the pyramidion, and its weight is estimated at 1168 tons. Quite near to it are the visible remains of two branches of the great embanked and paved way along which these masses of stone were dragged, these branches uniting in a single road which proceeds in the direction of the Nile. Baikie informs us that the sandstone paving, which still appears here and there, was designed to hinder the heavy weights from sinking into the surface of the embankment, and along this great piece of work innumerable masses of granite must have been moved for centuries by the simple means of the lever, the

Memphis was the first capital of United Egypt, remaining so from the 1st to the 6th Dynasty, after which its place was taken by Thebes. It is one of the most famous capitals of the ancient world and, according to Diodorus, was 150 stadia in circuit, which would equal 17.25 miles or 24.5 miles, according to whether the Greek or the Egyptian stadium is meant. Petrie is of the opinion that the larger circuit is true. This city is connected with the earliest traditions of Egypt and, while scarcely a vestige is to be found of the ancient capital, its necropolis on the adjacent range of hills contains many hundreds of remarkable tombs. The Memphian Necropolis extends from north to south a distance of 20 miles, with an average width of 2 miles. It was originally planned and laid out on a regular system of roads extending from north to south and from east to west. At the northern end, on a ridge of limestone, stand the great pyramids, and at the foot of this hill ran the ancient 'sacred road' which led in an easterly direction to the western boundary of the Heliopolitan nome over the hill of Babylon, in the neighborhood of the present Old Cairo. The whole long road was considered an enchanted region. Thutmosis IV, as a prince, spent his days hunting and driving in his chariot "with horses swifter than the wind". At the hour of the siesta, the prince and his companions were accustomed to rest by the side of the Great Sphinx, - "in that sublime place of ancient days near the Lords of Babylon and the road of the Gods, west of Heliopolis".

From Memphis the river, the canals, and the causeways spread

fanwise into the Delta and over these roads came and went both commerce and war. Three great highways have led eastward out of the Delta, between the Mediterranean and the Gulf of Suez, since very ancient times and are mentioned in the Bible as the "Way of the Land of the Philistines", the "Way of Shur", and the "Way of the Red Sea".

The northermost of the three, the Philistine Road, was the most direct route into Canaan and Syria and the one most commonly taken by the Pharaohs. This road passed through Zahi where there was a fortress and a bridge across the canal. A portion of the distance traversed by this road was through a region covered by the inundation of the Nile six months out of the year, during which time the road remained open to traffic. Brugsch calls it "the old royal road along the coast of the Mediterranean Sea, the well-known 'Road of the Philistines' of scripture, the road Zahi of the monuments." Strabo mentions it as coming in from the east near Pelusium. It crossed the line of lakes which form the bed of the Suez Canal, just north of Lake Ballah, at a point still known as 'El-Qantarah' or 'the Bridge'.

The central, or Wall Road, passed out of Egypt at Beer Makh-dal, and was the central route through Canaan. It was by this road that Abraham travelled into and out of Egypt. Jacob in all probability entered Egypt by this road "in the wagons which Pharaoh had sent to carry him" since the Septuagint statement tells us that "Joseph having yoked his chariots went up to meet Israel his father at Heroopolis".

The southern, or Red Sea Road, passed out of Egypt across the wilderness between the two arms of the Red Sea, from the head of the Gulf of Aqabah. This road is mentioned in a 19th Dynasty papyrus in which a scribe relates how he pursued two fugitives as far as the fortress of Thukoo where he was informed that they had already "got beyond the region of the Wall" and had decided to go by the southern route.

The Philistine Road was by far the most frequently travelled and the trade between Egypt and Asia over this road was considerable. Invading armies from Asia seem to have used this road exclusively. The records of Assurbanipal relate how after defeating Taharka, the latter fled to Thebes, pursued by the Assyrians. This record states that:

"In a march of a month and ten days through intricate roads my warriors pursued him up to Thebes. They attacked that city and razed it to its foundations."

The Persians under Cambyses, having defeated the Egyptians at Pelusium, marched to Memphis and on to Thebes where 50,000 troops were detached to march to the Great Oasis while the main body proceeded southward. A 'store house of Cambyses', found near the 3rd Cataract, indicates how far the Persians penetrated before famine overtook them and they were forced to march back. Again at Pelusium the Egyptians met defeat, this time at the hands of Alexander, who then marched as far as Memphis before turning back into the Delta to the coast where he selected the site for the most famous of all the cities to bear his name. The Moslems, after defeating the Romans in Palestine, marched on Egypt and captured Pelusium. They then

marched to Memphis and on to Alexandria. In the terms of surrender, the Egyptians agreed to feed the Mohamedan army and to construct bridges over the Nile for it on the march to Alexandria.

Alexander planned the construction of a vast roadway along the northern coast of Africa, to be built at an appalling cost, in order to furnish a highway for his army from Egypt to Carthage and the Pillars of Hercules. The city of Alexandria, which was not completed until after Alexander's death, was 30 stadia (3.75 miles) long and 7 stadia (0.88 miles) broad. Two main thoroughfares traversed the city, intersecting at right angles in the middle of the city; and all of the streets were wide enough for carriages. Pharos, an island in front of the city, upon which the famous lighthouse was constructed, was connected with the mainland by a stone causeway, known as the Heptastadium, so called because its length was seven stadia.

One of the oldest trade routes in history is the road between Coptos on the Nile and Kosseir on the Red Sea. Contrary to general opinion, the great movement of trade which came by the Red Sea did not enter Egypt by ship through the Gulf of Suez, because the shoals there were too dangerous, so instead, the cargoes were unloaded at Kosseir, which had been used from very ancient times, or at Berenice, which was established by the Ptolemies, and transported overland to Coptos.

This road, which is mentioned in the records of most of the Pharaohs from the earliest times, led through the Wady Hammamat and the Wady Foakhir, and was important not only because valuable quarries and gold mines lay along its route, but because

it was the road to Punt, the Holy Land of all Egyptians. The oldest known map in the world, drawn on papyrus, pertains to this road. It shows the location of the beds of gold, the position of stations, and the road dotted over with footmarks to show the direction to be taken. Whenever this road was improved after a period of decline, inhabitants and travellers gave vent to expressions of joy as exemplified by an inscription to Seti I (ca 1300 B.C.) which states:

"ye gods of the well! assure to him your length of life, since he has made for us the road to travel upon, and has opened what lay shut up before our face. Now can we travel up with ease, and reach the goal and remain living. The difficult road lies open before us, and the way has become good."

The Itinerary of Antoninus, which was a survey of all the military roads of the Roman Empire, included six Egyptian roads. One of these began at Contra-Pselcis in Nubia, followed the east bank of the Nile northward to Babylon, opposite Memphis, and then turned eastward through Heliopolis to Clysmon where Trajan's canal entered the Red Sea. A second road went from Memphis to Pelusium, thirty miles of it traversing the road mentioned above, joining it at Babylon and leaving it at Scenae Veteranorum. Travel from Pelusium to the head of the Red Sea was by these two roads; however, a third road through the desert lessened this distance by a hundred miles since it joined the first one at Serapion, about fifty miles from Clysmon, instead of at Scenae Veteranorum. A fourth road began at Hiera Sycaminon in Nubia, followed the west bank of the Nile to Andropolis, about sixty miles from Alexandria, where it left the river and proceeded on to Alexandria. A fifth road connected

Pelusium and Alexandria by keeping inland from the coast sufficiently to avoid the flat country which was under water during the inundation and joined the fourth one at Andropolis. The sixth road was that between Coptos on the Nile and Berenice on the Red Sea.

Aside from the main roads which were maintained and in constant use through several thousand years, ordinary roads crossed the deserts, equally old perhaps, but not as heavily travelled. On these roads all stones were swept to the sides, leaving a clear space 50 cubits (86 feet) wide. Petrie tells us that

"Two well preserved desert roads start from Saqqara, one to the Oases (Lesser) and one to the Fayum. Both are 50 cubits wide, clean swept, with all stones and pebbles piled in a ridge on either side. The Fayum road has waymarks of a pillar in a socket at every third of a mile, and a stele every four miles. At Amarna there are innumerable roads, 10 or 20 feet wide, across and along the plain, roads up to the tombs, up to the steles, patrol roads, quarry and desert roads."

Breasted mentions the desert roads from Abydos to the Great Oasis, from Edfu to Gebel Zehara, from Kubban to Abu Hammed and from Koruske to Abu Hammed, the latter two leading to the Sudan.

There can be no doubt that the Egyptian engineers were skilled road builders as early as the beginning of her known history. Brugsch informs us that there existed in Egypt, as early as 3700 B.C., an officer, the Superintendent of Works, who had charge of the construction and repairs of public buildings and roads. Of such importance were roads to the Nilotic civilization that the Pharaohs themselves took a personal interest in road making and numbers of them visited sections of

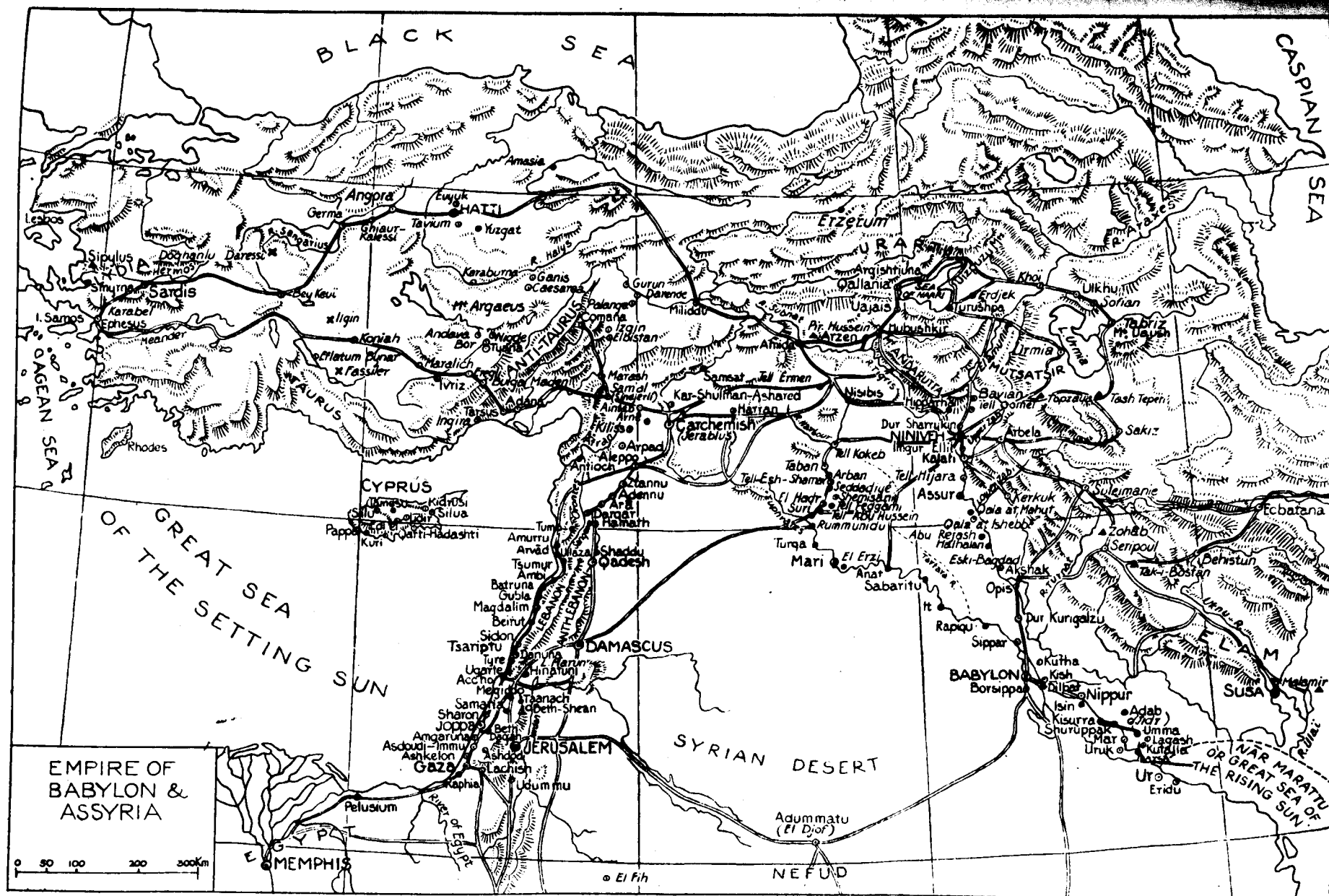
the country in person in order to determine for themselves the best solution for the problem in hand. Adam Smith states that the rulers of ancient Egypt

"are said accordingly to have been extremely attentive to the making and maintaining of good roads and navigable canals, in order to increase, as much as possible, both the quality and value of every part of the produce of the land, by procuring to every part of it the most extensive market which their own dominions could afford."

THE LAND BETWEEN THE RIVERS

"Broad is their way and their course is wide,
Where the seeds of destruction they sow,
O'er the tops of the hills where they stride,
To lay waste the smooth highway below, -
Broad is their way and their course is wide."

Incantation of the Seven Maskim - Sumerian



MAP OF THE BABYLONIAN AND ASSYRIAN EMPIRES

THE LAND BETWEEN THE RIVERS

The Mother of Civilization - until evidence to the contrary is presented, this title can rightfully be applied to that land lying between the Euphrates and the Tigris Rivers. Here was produced the first extensive civilization known to history, certainly one of the most creative and unique. Here was the garden from which have sprung our seeds of science, medicine, law, and business; one might even say religion, for it was from Ur of the Chaldees that Abraham went out into the land of Canaan carrying with him the Sumerian stories of the Creation and the Flood as well as a knowledge of the Sumerian code upon which the laws of Moses were largely based.

The Land between the Rivers, Babylonia in the South and Assyria in the North, was to remain mythological almost for many centuries. The tales that were told of its marvelous cities were nothing but garrulous tales of itinerant scribblers, or so it was believed, until the brilliant and patient research of archeologists laid bare a civilization whose grandeur exceeded that depicted by the historians. In Egypt the evidence of its glory, built of massive stone, has been preserved to this day because of the dry climatic conditions of the whole Nile Valley; whereas in Mesopotamia, the structures, built mostly of brick, were subjected to the disintegrating destruction of rain and floods and wind to such an extent that Nineveh, which fell as late as 607 B.C., was so completely covered that in 401 B.C., Xenophon, leading homeward the remnant of the immortal

10,000, passed by the mounds of this great city and never realized that here lay buried the palaces of the great Assyrian kings.

How old this civilization is, we do not know, and whether it originated in this region or in the Indus Valley, as some authorities believe, is a moot question. We do know that an advanced culture, coeval with the Sumerian, existed in the Indus Valley, as disclosed by archeological discoveries. This is true also of the region of Elam, immediately to the east of Babylonia, for at Susa has been unearthed the earliest known potters wheel, but more important still, the wagon wheel, whose influence upon mankind is distinctively unparalled as a factor in the advancement of civilization. Only later was this vital vehicle of civilization found in Babylonia, and still later in Egypt. As far as we now know, however, the Babylonians seem to have advanced farther in the direction of rights for the individual. Education, it appears from extant records, was available to all classes; property was the individual's, not the king's nor the priest's, and was held equally by men and women; trade was conducted for personal profit, by women as well as men, and not for the aggrandizement of palace or temple.

Babylonia was anciently divided into Sumer and Akkad. The cities embraced by the former, or southern district, were Ur, Uruk, Nippur, Larsa, Eridu, Lagash, Nissen and Umma; while those embraced by the latter, or northern district, were Akkade, Babylon, Borsippa, Cutha, Opir, Sippar and Kish. A high type of civilization flourished in this region as early as the fifth and the fourth millenium B.C., comparable with

and in many cases superior to the Egyptian, according to various authorities.

The Sumerians were primarily a commercial people, as was also true of the Babylonians. Actual business documents attest to the existence of widespread trade, and innumerable documents refer to roads and chariots. Made roads were indispensable since the whole of this country was low-lying and much of it was marshy.

Sargon of Akkad (ca 3800 B.C.) relates how "Over rugged mountains in bronze chariots I rode". An old Sumerian hymn, found at Nippur, and dedicated to King Ukusi by his grandson, King Udu of Kish (ca 3245 B.B.) states that

"The Strong Darru before whom the foe exists not,
Has driven the chariots over the mountain, has
scattered wide the seed."

King Tarsi of Kish (ca 3000 B.C.) relates in his Battle Hymn how "Indra (his patron god) laid low the fierce destroyer's fury. He set them different roads (in flight), did he the path's Controller." Gilgames, King of Uruk, is told by the goddess of love that "Thou shalt drive in a chariot of ukni stone and gold," and he then relates how,

"The road I was taking, and joyfully I went,
to the neighborhood of the mountains I took
at night."

Even the gods speak with familiarity of roads for Ea tells his son, Meridug, who has come to him for advice on how to cure a disease of the head, to

"Take a bucket, fill it with water from the mouth
of the rivers; impart to this water thy exalted
magic power, sprinkle with it the man - - - and
on the highway pour it out."

Ishtar descends into the Lower World "towards the dwelling that has an entrance but no exit, towards the road that may be travelled but not retraced." To drive chariots over rugged mountains and to travel over the roads at night certainly warrants the statement that well-made roads did exist at this remote period.

Suffice though this inscriptional evidence may be, we have incontestable proof that carts and chariots were in use at a very early date, because Wooley has found in the tombs of Ur heavy four-wheeled carts with bullocks harnessed to them, the driver's bones still in the carts and those of the grooms at the heads of the animals. The Mosaic "Standard" found at Ur shows on one side the Sumerian army of the time. Here is depicted a very early type of vehicle, four-wheeled chariots drawn by four asses. The chariots are low-hung on four solid wheels, each made of two pieces of wood clamped together and fixed to the axle which revolves with it; the tires, judging from actual examples found in the graves, seem to have been of leather.

King reports that

"During the reign of Shar-Gani-Sharri (Sargon) and Naram-Sin, a regular system of communication was kept up between Lagash and the court (Akkad). Incontestable evidence of a service of convoys between Akkad and Lagash under the direct control of the king's officers has been brought to light by discovery of seal impressions on whose underside were impressions of cords and knots thereby indicating that they were used to seal up bales or bundles of objects. Commercial tablets of this period bear witness to an active interchange of goods and produce between Lagash, Akkad, and other cities of the empire."

Wooley confirms this by stating that

"Tablets found at Lagash throw light upon the very business-like organization of the empire. Couriers passed frequently along the roads with instructions, and imperial officers were dispatched from Ur on special missions; incidently this meant further organization, for not only had the roads to be kept in repair, but provisions had to be made for the transport and rationing of the officials passing through on business."

Excavations at the northeast wall of Nippur disclosed a central roadway, leading into the city from the east, of thirteen foot width, for the use of beasts and vehicles, with a raised sidewalk on each side of more than four foot width for pedestrians. The whole structure was pre-Sargonic as evidenced by the type of brick used in the construction of the roadway. Hilprecht reports that the older brick were $8\frac{1}{2}$ " x $5\frac{1}{2}$ " x $2\frac{1}{2}$ " while the later ones were 11" x $7\frac{1}{2}$ " x 2", all laid in bitumen. The foundation was laid to a depth of five or six feet below the central roadway and according to Hilprecht it consisted of stamped earth mixed with potsherds and fragments of brick, and the outer edge of this road-bed was cased with large blocks of gypsum laid in bitumen to a height of more than two feet. The main road from the east led over this foundation into the city proper from the bridge over the moat.

One of the most interesting rulers of the Sumerian period is Gudea, patesi of Lagash, whose passion for beautifying his city led to quite an extensive movement of heavy building materials over great distances. Texts engraved upon his statues and upon large clay cylinders inform us that he brought great beams of valuable timber, 50 and even 60 cubits in length, and massive blocks of stone from the mountains on the coast of Syria and

in Arabia, copper from Elam, gold and silver and asphalt from other regions. The extreme difficulty encountered in transporting these heavy materials is related in the inscriptions. Gudea states that he cut roads into the mountains, in order to bring down the timber, where no man before had penetrated, and that he made roads into those mountains where he quarried the stone. After Gudea's peaceful and progressive reign, the land of Sumer was subjected to such devastating raids by the Gutians that "the Tigris and the seashore he (the King of Gutium) has occupied, - - - and the roads have grown long grass."

Babylon - the glamorous Queen of the Euphrates on the one hand and the shrewd Merchant Prince of the Orient on the other - owed its survival and grandeur during the four or five thousand years of its existence to its commercial position which made it an important center of trade even in the time when Kish, eight miles to the east, flourished under the great Sumerian kings. The City, at the junction of Upper and Lower Asis and accessible to the two great rivers making contact with the Persian Gulf and the Indian Sea possible, was in intimate communication with various countries whose merchandise travelled over the numerous roads which finally met at the great city.

Lenormant and Chevallier report that

"One of these routes, starting from Babylon, went northward, passed Ecbatana, the capital of Media, then turned eastward, passed Rhagae, traversed the famous defile of the Caspian gates, whence it descended into Hyrcania and passed by Hecatompylos, as far as the city called, later times, Alexander of Asia. There it divided into two branches - one of them tended northward to Bactria, the other turned southward towards India by way of Drangiana and Arachosia, passing the cities of Prophthasia, Arachosia and Ortospana. At

the latter place the road again divided in three, called by the ancient geographers the trivium of Bactria. The first, running directly east, entered India by way of the cities of Peucela (Pushkalavati), and Taxila (Takshacila). From Taxila the road turned south, crossed the Hydaspes (Vitasta), and Hyphasis (Vipaca), and thence went on to the confluence of the Ganges and the Iomanes (Yamuna) at Palibothra (Pataliputra). The second road leaving Ortospana arrived at the same termination, passing through Arachosia; the third, turning north, entered Bactria and went on through Marachanda, as far as the Iaxartes."

To the north and west by the Euphrates route, another road served northern Syria, thence turned south to Palestine and Egypt. Cappadocia, Phrygia and countries along the Aegean and the Black Sea were served by a road, known centuries later as the Royal Road of the Persians, described by Herodotus, which went east from Babylon to Susa, turned north through Assyria towards Armenia, crossed the Euphrates and the Upper Halys Rivers and went on to Sardis and Ephesus. Traffic along these roads and their numerous branches must have been ancient indeed since there was a trading colony already established at Ganes in Cappadocia before the reign of Sargon of Akkad as evidenced by an appeal to him for protection against a local native king. A clay cylinder written by a Babylonian king in the fifth century B.C. informs us that Harran (Road Town) was from time immemorial second only to Ur as a chief center of the Moon God's worship. Harran, as the name implies, was an important road center, and it was here that Abraham remained until Terah died.

South of Babylon lay the important cities of the old empire and the Persian Gulf. Evidence has already been presented that

roads connected these cities as early as the reign of Sargon of Akkad. Near the sea were vast lagoons in which thrived, in enormous beds, reeds to the height of from 13 to 16 feet. That roads existed even in this marshy region is proven by an Assyrian bas-relief from the palace of Nimrud, which depicts mounted warriors riding through gigantic Chaldaean reeds reaching above their heads, while through these reeds flows a stream filled with fish. Traversing regions such as this on horseback would obviously be impossible without well-built roads.

Babylon and Assyria differed considerably in their political viewpoints, the former was concerned mainly with the peaceful pursuit of trade, while the latter was controlled almost entirely by military conquests. This difference in viewpoint between the two people is brought out by King, who says that

"In contrast to that of Assyria, the history of Babylon is more concerned with the development and spread of a civilization than with the military achievements of a race. Her greatest period of power was under her first line of kings; and in after ages her foreign policy was dictated solely by commercial needs."

The city of Babylon was not only a trade center for merchandise coming from all directions, but the country itself was famed for its manufacturing. This fame lasted into classical times for Nero had one of the rooms in his palace hung with Babylonian tapestries which cost more than \$160,000, and Cato is reported to have sold a Babylonian mantle because it was too costly for a Roman to wear.

The most splendid example of road construction of which we

have any record or actual remains is the Sacred Road or the Procession Street of Babylon. This street, which was a continuation of the road from the north, traversed the entire length of Babylon in a straight line from north to south. This broad roadway, still preserved, consists of a substratum of brick laid in and covered with bitumen upon which rests the massive superstructure, the center of which is laid with mighty flags of fine hard limestone measuring 1.05 meters each way and 34 centimeters thick, and the sides with slabs of red breccia veined with white, 66 centimeters square and 20.5 centimeters thick. The joints of these blocks were bevelled and were filled in with asphalt.

One of Nebuchadnezzar's inscriptions states that

"From Dulazag, the place of the decider of fates, the Chamber of Fates, as far as Aibur-Shabu, the road of Babylon, opposite the gateway of Beltis, he (Nabopolassar) had adorned the way of the procession of the procession of the great lord Marduk with turminabanda stones. Aibur-Shabu, the roadway of Babylon, I filled up with a high filling for the procession of the great lord Marduk, and with turminabanda stone (breccia) and with shadu stone (limestone) I made Aibur-Shabu, from the Illu Gate to the Ishtar Gate, fit for the procession of the godhead. I connected it together with the portions that my father had built and made the road glorious."

One of the pavement bricks bore an inscription which told how

"The streets of Babylon, the Procession Street of Nabu and Marduk my lords, which Nabopolassar, King of Babylon, the father who begat me, had made a road glistening with asphalt and burnt brick: I, the wise suppliant who fears their lordships, placed above the bitumen and burnt bricks a mighty superstructure of shining dust, made them strong within with bitumen and burnt bricks as a high-lying road."

Koldewey informs us that the roadway lies high (12.5 meters)

and is built at an easy gradient from the north upwards to the Ishtar Gate, but that before Nebuchadnezzar's time it was considerably lower as evidenced by another portion which is the same in width and paved with brick, plastered with asphalt. In the length of this roadway, up to the bridge across the Euphrates, Koldewey reports finding several superimposed pavements of baked brick, separated from each other by shallow layers of earth.

Additional information is given by King who states that

"When clear of the citadel the road descends by a gradual slope to the level of the plain, and preserving the same breadth, passes to the right of the temple dedicated to Ishtar of Akkad. As it continues southward it is flanked at a little distance on the east by the streets of private houses; and on the west side it runs close under the peribolos of E-temen-anki, the Tower of Babylon. As far as the main gate of E-temen-anki its foundation is laid in burnt brick, over which was an upper paving completely formed of breccia. The inscription upon the slabs corresponds to that on the breccia paving stones opposite the citadel; but they have evidently been re-used from an earlier pavement of Sennacherib, whose name some of them bear upon the underside. At the south-east corner of the peribolos the road turns at a right angle and running between the peribolos and E-sagila, the great temple of the city-god, passes through a gate in the river wall built by Nabonidus and so over the Euphrates bridge before turning southward again in the direction of Borsippa. This branch road between the Tower of Babylon and E-sagila is undoubtedly the continuation of the procession street. For not only was it the way of approach to Marduk's temple, but its course has been definitely traced by excavation. But there can be no doubt that the upper portions of the road, running north and south through the city, was continued in a straight line from the point where the Sacred Way branched off. This would have conducted an important stream of traffic to the main gate in the southern city-wall."

That a city as large as Babylon could have existed thousands of years ago seems quite unbelievable. Herodotus reports that the wall surrounding the city was in the form of a square, 120

stadest (13.8 miles) on a side or 480 stades (55 miles) in circuit, with a height of 200 royal cubits (341 feet), and a width of 50 royal cubits (85 feet). Nebuchadnezzar, who completed the work started by Esarhaddon, states on an inscription that he caused the great wall of Babylon to be measured 4000 mahargagar. This distance corresponds exactly with the 480 stades given by Herodotus. Koldewey found that the great wall was made up of two brick walls, 7.0 and 7.8 meters in width respectively and that the intervening space of 12 meters between them was filled with earth. The total width of the wall being therefore 26.8 meters or 88 feet verifies Herodotus' statement as to the width being 85 feet. Rawlinson informs us that one hundred gates pierced the wall, twenty-five on a side probably, and that the roads led straight to these gates. Since all roads in Babylon, from earliest times, were built at right angles to each other, and since the length and width of the city was 13.8 miles, the total length of the main roads alone, leading up to these gates, equalled approximately 700 miles.

Two remarkable structures in Babylon, in fact the earliest of their kind in existence, of which we have any record, were the stone bridge across and the brick tunnel under the river Euphrates. Both of these are said by Diodorus to have been built by Queen Semiramis of Assyria about 2100 B.C. Regarding the bridge, Diodorus, quoting Ctesias, writes that

"Semiramis fixed on the place where the Euphrates was narrowest and threw across it a bridge five stades (3033 feet) long. She contrived to build in the bed of the stream pillars twelve feet apart, the stones of which were joined with strong iron cramps fixed into the mortises with melted lead. The side of these

pillars towards the run of the stream was built at an angle, so as to divide the water, cause it to run smoothly past and lessen the pressure against the massive pillars. On these pillars were laid beams of cedar and cypress, with large trunks of palm trees, so as to form a platform thirty feet wide. In front of each end of the bridge she built a castle flanked by towers, and surrounded by triple walls."

A bridge, much smaller and built of brick, has been discovered in Babylon, but was of much later construction. The Procession Street ends at this bridge regarding which Koldewey reports that

"Seven river piers have been excavated. The complete length of this bridge as far as has been made out, amounted to 123 meters, and the pier lengths of 21 meters may have exceeded the breadth of the roadway very considerably. The piers are 9 meters wide and are placed 9 meters apart. They are built with a very marked batter. Their bricks are of the small size 31 x 31 centimeters and are unstamped, from which we may conclude that the building dates from Nebuchadnezzar's first period or from Nabopolassar. There are rectangular cavities in the piers in which, as far as we can judge, strengthening baulks of wood once lay 50 centimeters apart. Above this, at a distance of 2 meters, there was a second similar course of wood. The sides of the piers are convex and meet in a point in front facing the current on the north. The back is also slightly curved. Thus the ground plan of the pier follows the water-line of a ship."

Among the Babylonian texts that refer to this bridge, it is described by Nebuchadnezzar as the work of Nabopolassar, who "had erected piers of burnt brick for the crossing of the Euphrates."

The other remarkable structure, of which as yet no remains have been found, was the tunnel described by Diodorus and Philostratus. Semiramis, having completed the bridge, then constructed another prodigious work, according to Diodorus, by diverting the Euphrates River from its course and "building in

the dry bed of the river a covered way leading from one castle to another." Construction having been completed,

"the river then was allowed to return to its bed, and Semiramis could then pass dry shod under water from one of her castles to the other. She placed at the two ends of the tunnel gates of bronze said by Ctesias to be still in existence in the time of the Persians."

Since the bridge connecting the castles was 3033 feet in length it is apparent that the tunnel was at least this long. The construction was of brick laid in asphalt and the roof was built in the form of an arch. This tunnel which was fifteen feet wide and twelve feet high to the spring of its arched roof is the earliest one recorded by history although it appears doubtful that the perfection of design and the successful completion of such an audacious piece of work would be possible without a background of previous knowledge and experience. History does not again record the successful completion of another tunnel under a river until 4000 years later when the tunnel under the Thames River was constructed in 1842 A.D.

The Assyrians, who wrested control of the Land between the Rivers from the Sumerians and in turn were forced to bow to the Babylonians, appear to have been road builders par excellence amongst the ancient peoples. Not only do frequent references to road construction occur in the inscriptions, but pride of accomplishment is manifest in the expressions. Sayce reports that the Assyrian engineers were indeed skilled in the construction of roads, and the inscriptions not infrequently boast of their success in carrying them through the most inaccessible regions.

Ninus, the first ruler of the Assyrian Empire, had made himself master of all the countries between the Mediterranean Sea and the Indus River, but death decreed that Semiramis, his queen, was to administer authority over this empire. Having completed her work in Babylon, Semiramis made an expedition against the Medes, who had revolted, went on to Persia, and then visited all of her possessions in Asia. Ctesias reports that wherever she went she pierced mountains, levelled rocks, and constructed large and good roads.

Alexander the Great read one of her triumphal stelae, erected near Iaxartes on the frontiers of Scythia. In this text, preserved for us by Polyaeus, Semiramis writes that

"Nature gave me a woman's body, but my deeds have equalled those of the most valiant men. I ruled the empire of Ninus, which reaches eastward to the river Hidaman (Indus); southward to the land of incense and myrrh (Arabia Felix); northward to the Saces and Sogdians. Before me no Assyrians had seen a sea; I have seen four, that no one had approached, so far were they distant. I compelled the rivers to run where I wished, and directed them to the places where they were required. I made barren land fertile, by watering it with my rivers. I built impregnable fortresses. With iron tools I made roads across impassable rocks; I opened roads for my chariots, where the very wild beasts had been unable to pass. In the midst of these occupations I have found time for pleasure and love."

Tiglath Pileser I, King of Assyria (ca 1150 B.C.), "the opener of the roads of the countries" describes how he traversed sixteen mighty mountains, opening roads with bronze axes.

The cuneiform inscription relates that

"the easy parts in my chariots, the difficult parts in wagons of iron, I passed through; the thickets of the mountains I cut down; bridges for the passage of my troops I prepared."

The Annals of Assur-nasir-pal (883-858 B.C.) contain numerous references to cutting down and receiving by tribute beams and other timber for bridges. One of these references states that

"I proceeded to the land of Iz-mehri, and took possession of it throughout: I cut down beams for bridges of mehri trees, and carried them to Nineveh."

We find also in these annals that metal rollers were used in the construction of roads for we read that

"to Lara, (the rugged hill-country, unfitted for the passage of chariots and armies, with axes of iron I cut through and with rollers of metal I beat down)"

and again that

"six lakes I crossed over in Kasyari, a rugged high-land for the passage of chariots and an army unsuited; (the hills with axes of iron I cut through and with rollers of metal I beat down;) the chariots and army I brought over."

We learn that Tukulti Urta acquired control of both roads into Babylon and that later when his troops were marching through Suhi land, the mountains in one place came so close to the river that it was necessary to cut a road with iron axes.

During his campaign against Zikirtu and Andia in 714 B.C., Sargon was unable to secure a passage over Mount Simiria until a road was opened by cutting through the rock of the mountain by the use of mighty axes of bronze. In another of his tablets Sargon states that

"Between the high mountains, the elevated ravines, the peaks of the difficult mountains, which pass all describing, and in their recess was no road for the advance of my body-guard. The great trunks I cut down and the difficult peaks with axes of copper I cut. A narrow road, a passage, a street, where the body-guard could pass by the side, for the advance of my troops between them I constructed."

The roads just mentioned were of course built through rugged,

almost inaccessible regions and were intended primarily for military purposes. In the well developed regions of the empire stone and brick roads were built and carefully maintained. Here, fortunately, we can turn to actual remains of roads brought to light by archeologists as well as to bas-reliefs and inscriptions. Nebuchadnezzar I (1146-1133 B.C.) in his campaign against the Elamites, who had been raiding Babylon, set out from Der, the frontier city of Anu, and marched continuously for 60 hours. The season being summer, he reports that "the metal axes burned like fire, and the heat of the stones on the road blistered the feet."

One bas-relief shows a village across the valley from Alammu with a suburb on the near bank. The cliff rises sheer from the water's edge and access to the fort at the very top is along a stone road supported by frequent embankments. Olmstead remarks:

"Our surprise at finding such a road among the wild Kurdish hills of today is increased when we identify it with the conspicuous road in the bas-relief up whose steep grade Assyrian fighting machines were being forced."

Regarding the little known ability of the Assyrians as road builders, Olmstead has this to say:

"So often have we considered the Romans as the first to develop the road system in a practicable manner that we can with difficulty believe that they had predecessors. Sennacherib has left us two stelae on which he tells us how he enlarged the site of Nineveh and extended its streets, the track of the royal road. On a memorial stone he has placed this order: "Royal Road, let no man decrease it." Seventy-eight feet he has measured its breadth and if in the future any citizen shall restore his old home or build it anew from its foundation and so encroach on the road, before his home on a pole they shall impale him. The stelae were found southeast of the palace on the way to Arbela, and by their position prove that this paved road was the ancestor in line as

it was doubtless in name of the better-known Royal Road of Persian Times."

Nineveh, whose splendour and grandeur made it famous as one of the most marvelous cities in history, was second only to Babylon. Situated as it was in that portion of the Fertile Crescent between the Tigris, the Upper Zab and the hills, it controlled a considerable amount of traffic flowing in from all directions. From seven of the many gates of the city led out the following roads:

N	-	Road to Dur Sharrukin
N E	-	Road to Shibaniba
E	-	Road to Arbela
S E	-	Road to Zaban
S	-	Road to Kalhu
W	-	Road to Kalhu and Ashur
N W	-	Road to Tarbisu

As in the case of Babylon and other cities, the streets of Nineveh were laid out in checker-board fashion and were paved with large slabs of limestone, many of them still bearing the grooves worn deep by wheeled traffic.

Sargon in 711 B.C. decided, while still in the midst of his military successes, to create an entirely new capital fifteen miles distant from the ancient capital, Nineveh. This city he called Dur Sharrukin or the Castle of Sargon. The paved stone road which led to the new city was forty feet wide and was continued within the gate as a street of the same dimensions.

Maspero tells us that

"The road which leads to Dur Sharrukin crosses the

Khosr when it leaves Nineveh, and follows the left bank of the river pretty closely. It is a good stone road, like all in Assyria, about twelve yards wide, bordered at regular intervals with stone posts, which mark the distances. It ends after many turns at the gate of Ishtar, to the south west side of the city. There were eight gates, two on each side, and the streets, which start from the gates, retain in every direction the width of the roads they continue. They are paved in the same way, have sideways, or footpaths, and are intersected at right angles."

The Assyrians were quite as adept as the Egyptians in the transportation of great weights. Colossal bulls, carved in elaborate detail at the quarry site, transported over great distances, and placed on artificial platforms 30 to 80 or 90 feet high, not only indicate considerable mechanical skill, but certainly indicate that they had no fear of any accident happening in transit.

Although the rivers of the country were accessible to traffic we find that concern of the roads is always of primary importance. In an oath of allegiance which Zakutu, widow of Sennacherib, demands for her grandson, Ashur-bani-apal, from all subjects, is included the promise that "The road for his feet we will establish, the kingdom of Ashur and Akkad we will support by the oath of the gods." Even a king's son, it appears, is not privileged when it comes to road and bridge construction except special authority be granted, as cited by the example of Meli-Shipak (1216-1202 B.C.), who made a grant of a piece of property near the old city of Akkad to his son Merodach-Baladan I. On a boundary stone is given the size and situation of the estates, the names of the high officials who had been entrusted with the duty of drawing up the survey, and a text

defining the privileges granted along with the land. Among the privileges listed thereon, the king freed the land from the corvee and also freed his son from all liability to build a road or a bridge for the public convenience, even though the king or the governor should give the order.

Trade was the life blood of the Land between the Rivers as attested to by the thousands of business documents unearthed in various localities. How old this trade is we do not definitely know as yet, but that it was very extensive is proven by the presence of articles of exchange all the way from the Indus to the Nile, and by extant documents setting forth business transactions. Layard informs us that highroads and causeways across the desert united Syria and Palestine with Babylon, that fortified stations protected the merchant, and that walled cities served as resting places and storehouses. Continued success in uncovering the remains of ancient cities in India will before long, no doubt, bring supporting evidence of similar trade enterprises in that direction. Unfortunately, the few remains of roads which have been found, are generally in or adjacent to the ancient cities. That not more roads have been located is not surprising in view of the fact that magnificent cities, miles in extent, have been buried under tons of debris throughout two thousand years and more without anyone realizing that such cities existed except in the realm of crystallogancy.

CHINA

"But the ways of Chou are smooth as a grindstone,
Their straightness is like an arrow."

Shi King (The Book of Songs)

CHINA

The civilization of China was conceived, nurtured, and attained its full growth, in the valley of the Yellow River. In comparison with the other great river-valley civilizations of antiquity which developed along the Nile, the Euphrates and the Tigris, and the Indus, the emergence from barbarism was the result of a gradual development of certain fundamental traits such as writing, building towns and roads, casting bronze, making use of the wheel in transport, domesticating animals, and practicing agriculture on a large scale. It likewise shared with these others the unique condition that each one developed a civilization which was essentially and characteristically its own. Unfortunate for us, however, was this dissimilarity, that the Chinese built mostly of wood and wrote their records on tablets of wood or bamboo which were readily destroyed by nature through deterioration and by man through ignorance.

As is the case with the Nile, China's Great Sorrow, the Yellow River, seems to have obliterated the idea of any other system of transport except that by the river and its very numerous canals. This fallacy, however, is of our own making. For the literature of ancient China is replete with the words for roads, carriages and horses; these terms, moreover, are not used in the sense of a stranger which one meets but distantly; rather do they appear in the light of an old and tried

friend with whom one has lived a long time. A collection of verse by Chinese skilled in feudal law contends that the ancient sovereigns, from remotest antiquity, made uniform roads at the same time as they achieved uniformity of writing and customs.

In the Shi King, or the Book of Songs, we meet with life on the road in its various moods. Here we find the homesick traveler whose plaint is that

"My four steeds are weary,
The high road is very far.
Indeed, I long to come home;
But the king's business never ends.
My heart is sick and sad."

The march of panoplied warriors thrills us for

"Lo, we were plucking the white millet
In that new field,
In this fresh-cleared acre,
When Fang-shu arrived
With three thousand chariots
And a host of guards well-trained.
Yes, Fang-shu came
Driving his four dappled greys,
Those dappled greys so obedient,
In his big chariot painted red,
With his awning of lacquered bamboo
And his fish-skin quiver,
His breast-buffers and metal-headed reins."

The bride passes us by and we see

"Four black horses well-groomed,
Dangling reins all glossy.
The Lu road is easy and wide;
All happiness to this lady of Ch'i!"

The experienced traveler advises us that

"On the journey you will lodge at Kan;
You will drink the cup of parting at Yen,
Grease wheels, look to axle-caps,
And the returning carriages will go their way:
"A quick journey to the court of Wei,
And may you get there safe and sound."

And even the bustle of life along the roads must pause when,

"If along the highroad
I caught hold of your hand,
Do not be angry with me;
Friendship takes time to overcome."

It is difficult to determine just at what period the made road, the horse or the carriage came into being. The domestication of the horse is credited to Fu-hsi (ca 2852 B.C.), the establishment of markets for the exchange of commodities to Shen-nung (ca 2737 B.C.), and the invention of wheeled vehicles to Hwang-ti (ca 2704 B.C.). Sze Ma Tsien, known as the "Herodotus of China" commences his history with the reign of Hwang-ti, "The Yellow Emperor". It was during this reign that the limits of China were extended eastwards to Shan-tung and southwards to the Yang-tsze-kiang valley. Hwang-ti unified the scattered tribes under one polity and maintained effective control over his empire by means of a network of roads which he ordered to be constructed so that different parts of the country were joined together. Wheeled carts were invented to carry heavy loads, trade was promoted through the establishment of markets and fairs, and weights and measures were defined by law. Although Hwang-ti is credited with all of these innovations, it is incredible that one man could do all this along with all of his other accomplishments. It would appear, therefore, that the roads, the carriages, and the trade already existed, but were brought into focus for the first time as a result of complete unification under one ruler.

We learn also from the Shu-king that Yao (ca 2357 B.C.) "drove in a red car drawn by a white horse", and that Shun,

who served as regent under Yao for 30 years before taking the throne in 2258 B.C., traveled yearly all over the nation in an official capacity, continuing this practice after he became emperor. The greater part of this travel was by chariot which obviously indicates the existence of a road system. During these journeys about the country, Shun worshipped on top of the sacred mountains; one each in the north, south, east and west. These mountains have been held sacred down to the present day. It is said that hundreds of thousands of pilgrims yearly visit Tae Shan, the eastern mountain, and that during the Chinese New Year as many as 10,000 a day make the ascent. A road about twelve miles long leads up to the top of Tae Shan from the town of Taranfu and the latter half of the ascent is made almost entirely up flights of broad stone steps, said to number more than 6,000.

The Chinese have down through the centuries shown a remarkably clear conception of the principles of engineering, and this is true with respect to road construction as well as to irrigation and flood control work. The vast territory over which the Chinese held control would perforce indicate an outstanding ability for utilizing every means of communication. Regardless of the terrain, they have shown consummate skill in overcoming the difficulties of nature. An example of the ingenuity displayed by the Chinese in overcoming highly adverse conditions was the construction of a road over the Two-Edged Sword Mountains. This range, forming an almost impassable barrier between Szechwan, lying on the Tibetan border, and the

rest of China, is so high, its cliffs so precipitous, and its passes so few, that it is almost impossible to cross it. In order to provide a passageway over these mountains, a 'chan tao', the 'flying' or 'terraced' road was invented.

This unique type of road was constructed by cutting holes in the face of the cliffs, driving piles into them at an angle, and securing them in place with mortar. Logs were then laid across these piles and tamped earth on top of the logs completed the roadway. These roads were so solidly constructed that wheeled traffic used them in safety, provided of course, the vehicles did not fall over the edge which did not always have a protection in the form of a railing.

This road, first mention of which is made in the Han Dynasty, is graphically portrayed by Li Tai-po in "The Perils of the Shu Road" in which he tells us that

"The Shu Road is as perilous and difficult as the
way to the Green Heavens.
No greater undertaking than this has been since
Ts'an Ts'ung and Yu Fu ruled the land.
How the road coils and coils through the Green
Mud Pass!
With nine turns to a hundred steps, it winds round
the ledges of the mountain crests.
Clutching at Orion, passing the Well Star, I look
up and gasp.
I sit long with my hand pressed to my heart and
groan.
Alas! How endless a road for man to undertake! How
came he to attempt!
The Terraced Road of the Two-Edged Sword twists
between glittering and rocky summits."

The oft-quoted saying that in China a road is good for seven years and then bad for four thousand can undoubtedly be applied to the roads which have been encountered by nineteenth and twentieth century travelers, but there seems to be no grounds

for thinking that failure to properly maintain a road once constructed, is other than just an hallucination which seems to have been attributed to the mysterious workings of the Oriental mind. A nation whose size necessitated efficient and large scale trade and communication service, which showed considerable ability and ingenuity in building roads, would certainly not be wanting in sufficient common sense to realize the importance of proper maintenance as applied to roads. Two such widely separated periods as the 13th Century B.C. and the 13th Century A.D. may be used to illustrate the fact that road maintenance was a matter of common practice. Referring to the former period, we learn that Wu Ting (1324-1265 B.C.), searching for a man qualified to assist him in governing the Empire, found such a man in the person of Hu-yueh, who was very poor, and when discovered was engaged in repairing the public roads. Referring to the latter period, we learn from Marco Polo that officers of rank were appointed whose duty it was to see that the roads were constantly kept in good order. Both bronze inscriptions and books show that roads were kept in repair, and sometimes planted with trees; rest-houses and inns were provided by the government for travelers; and merchants ranged from one end of China to the other.

The fame of Tsin shih hwang ti (221-210 B.C.) is quite secure as the builder of the Great Wall with its paved road on top traversing its entire length, but stupendous as this work was, it was only one portion of a general plan for connecting the various parts of the Empire with good roads. Gowen contends that

"one's admiration of the wall is even excelled by the feeling of wonder at the many other great engineering undertakings, the piercing of mountains, the levelling of hills, the bridging of rivers, by means of which the conquests of Tsin shih hwang ti were made secure and imperial unity consolidated."

This Emperor, at the very beginning of his reign, realized the importance of improved transportation for he began construction of a vast network of roads in 220 B.C. at which time "the imperial highways were traced". Like the earlier monarchs, Tsin shih hwang ti traveled all over his empire, from one end of China to the other, accompanied by a great crowd of chariots and attendants, inspecting his domain, regulating the laws and industries, and sacrificing to the hills and streams. The roads, which were said to stretch in every direction from the capital to the extreme bounds of the empire, were built to a width of fifty paces, planted with trees on each side, and were raised so as to be out of reach of the floods.

During his rise to power, Tsin shih hwanh ti had observed that the existing roads were given only such attention as was necessary, and that when he first went on his inspection trips only such roads as he traveled were repaired for his particular passage. Realizing the true condition of the roads, he expressed himself thus:

"These roads have been made expressly for me, and are very satisfactory. But it is not just that I alone should enjoy a convenience of which my subjects have still greater need, and one which I can give them. Therefore, I decree that good roads shall be made in all directions throughout the empire."

In 212 B.C., construction was started on a great road leading to the North, as far as the great bend of the Yellow River;

"cuttings wre made in the mountains, embankments in the valleys, and communication was established in a straight line."

This same road was repaired by Wu ti (140-86 B.C.) who also was greatly interested in the construction and improvement of roads. Another great road, similar to the one towards the North, was constructed by him towards the South-west, thereby completing the great cross-system of Tsin shih hwang ti. The many inspection trips made by Wu ti resulted in the construction and maintenance of numerous roads, especially in the year 112 B.C.

Kao Hoangti, who succeeded Tsin shih hwang ti, selected as his capital the city of Singanfoo in the western province of Shensi. Since this city lay in an almost impenetrable section of mountains, it was necessary to construct roads over and through these mountains, work which required the services of an army of workmen, one hundred thousand in number. Valleys were crossed on embankments made from materials excavated from the nearby mountains, and where this method was not feasible, great bridges, supported on high bents, spanned the valleys. Where deep ravines were to be crossed, suspension bridges or 'flying bridges' - as they were called - were built, wide enough to permit four horsemen to ride abreast, their sides protected by high balustrades. It is interesting to note that this type of bridge was employed by the Incas of Peru long before the Spaniards arrived, and was not attempted by Europeans until nearly 2000 years after it had been employed by the Chinese.

According to Gregory

"The ancient road system of China was on a magnificent scale. The Imperial roads played in South-eastern Asia the part of the Roman roads in Western Europe. Many of them were broad and well built and paved with massive slabs of stone. Rivers were crossed by bridges or well managed ferries. The steep mountain walls were traversed by stone-paved stairways with treads so broad and steps so low that they could be climbed by laden mules. The ascents were shortened by tunnels through the crests of ranges."

The Mongol invasion brought wholesale death and destruction in its wake, but once a nation was conquered, peace and security became as effective as the conquest itself. The whole known world lived in constant dread of this onrushing wave of destruction. One writer, whose description is equally applicable to all countries, states that

"In the year 1240 a detestable nation of Satan, to wit, the countless armies of the Tartars, broke loose from its mountain-environed home, and piercing the solid rocks of the Caucasus, poured forth like devils from Tartarus. Swarming like locusts over the face of the earth, they have brought terrible devastation to the eastern parts of Europe, laying it waste with fire and carnage."

Mathew Paris, the medieval historian, was quite justified in so depicting the Mongols, yet it was this same 'detestable nation of Satan' which pried open the door into Asia and kept it open for a whole century.

The most astounding characteristic of these nomadic barbarians was their chameleonic adjustment to the civilizations they conquered. Conquest brought with it freedom of worship, freedom of trade and complete protection against crime. It was said that a girl might carry a bag of gold from one end of Asia to the other and not be harmed. Not only was trade, communications,

and travel safe, but the means whereby it could be accomplished was provided for. Highways were constructed and maintained throughout the vast empire, excellent inns providing every comfort and fit for even the Emperor to stay in were built every twenty-five or thirty miles, and a postal service functioned from one end of the empire to the other.

Marco Polo speaks freely of the paved roads and the bridges throughout China during the reign of Kublai Khan. He tells us that in the noble and magnificent city of Kin-Sai (Hangchow) the streets were all paved with stones and bricks, and so

"likewise are all the principal roads extending from thence through the province of Manzi (Southern China), by means of which passengers can travel to every part without soiling their feet; but as couriers of his majesty, who go on horseback with great speed, cannot make use of the pavement, a part of the road, on one side, is on their account left unpaved."

He also informs us that

"when you leave Koi-gan-zu, you ride south-east for a day along a causeway paved with fine stone. This is at the border of the Kingdom of Manzi. On both sides there is a great expanse of water, so that you cannot enter the province except over this causeway."

This same road went on still farther to the great city of Yanju (Yangchow). With respect to the streets of Kin-Sai, Marco Polo tells us that

"The main street of the city (forty paces wide) leading in a direct line from one extremity to the other (one hundred miles in circuit) is paved with stone and brick to the width of ten paces on each side, the intermediate part being filled up with small gravel, and provided with arched drains for carrying the rain water that falls, into neighborhood canals, so that it remains always dry. On this gravel it is that the carriages are continuously passing and repassing."

Kublai Khan, in extending the Grand Canal from Kwachow over

a distance of six hundred miles to Peking, utilized the labor of thousands of workmen for a period of seven years. This canal was banked with stone and the earth from the entrenchment was cast up on both sides of the canal and made into raised highways. In commenting on the construction of this canal, Marco Polo states that

"A road is there also, for they threw up the earth from the channel to form an embanked road on both sides."

Rashiduddin, a Persian writer and a contemporary of Marco Polo, gives us more information about the road which paralleled the Grand Canal for we learn from him that

"Along the side of the canal runs the highway to Machin (Canton) extending over forty day's journey. This road has been paved all the way so that travelers and animals may make the journey in the rainy season without sinking in mud."

This same authority further states that

"shops, taverns and villages line the road on both sides, so that there is one house after another, without any space between, for the whole distance of forty day's journey."

It has been justly said that the glory of the Chinese roads is their bridges. How old the art of bridge building is we do not know, but it is evident that they were quite commonplace as early as 1152 B.C. for Khi, the ruler of Wei, tells us that

"Now the Yin Dynasty, in its submersion and decay, resembles a great river without a bridge or a ferry."

Two bridges are of particular interest, and although described by Marco Polo, they were constructed long before his time. One of these, about ten miles from Cambulac (Peking)

"is a very handsome bridge of stone, perhaps unequalled by another in the world. Its length is 300 paces (1500 feet), and its width 8 paces (40 feet); so that ten men

can, without inconvenience, ride abreast. It has twenty-four arches, supported by twenty-five piers erected in the water, all of serpentine stone and built with great skill. On each side, and from one extremity to the other, there is a handsome parapet, formed of marble slabs and pillars arranged in a masterly style."

Regarding the other bridge, located in Chengtufu in the province of Szechwan, Marco Polo says:

"Let us now speak of a great bridge that crosses the river in this city. The bridge is built of stone and is seven paces (35 feet) wide and a half a mile long - the river being that wide there, as I told you. All along the length of this bridge, on both sides, there are marble columns to hold up the roof. For the bridge is roofed over from one end to the other with richly painted timber."

The Imperial highways which anciently led out from the former capitals of China such as Sian-fu, Nanking and Chengtu, have radiated from Peking since that city became the seat of government. Main roads led in different directions to the extremities of the empire, incorporating large parts of the much older roads. Of these, the 'Ambassador's Road' is probably the best known since it was over this road that the early ambassadors to the Imperial Court traveled. This road leads south from Peking passing through Tehchow, Suchow, Luchow, Kiukiang - where it crosses the Yangtze River - Nanchang, thence up the Kan Kiang and over the Meiling Pass down into Kwang-tung and on to Canton, its terminus.

The eastern road from the capital follows the Ambassador's Road to Tehchow where it bears south-east to Tsinan, thence to the coastal cities of Chingkiang, Hangchow, Wenchow, Santuao and Foochow. Another road leads north-east from Peking to Mukden in Manchuria.

Two main roads which lead to the north-west across the Gobi Desert into Mongolia branch off at Kalgan after going near the Ming Tombs and through the Nankou Pass. The northernmost of these goes through Urga to Kiachta, while the other passes through Uliassutai, Kobdo and Semipatalinsk.

The remaining roads lead to the south and west, one of which goes through Weihwei, Kaifeng, Nanyang, Siangyang, Changteh, Yuanchow, Kweiyang to Yunnanfu. From this road another branches off to the south of Kaifeng passing through Hankow, Changsha, Hengchow and so to Kweilin. At Hengchow a branch road connects with the Ambassador's Road below the Meiling Pass.

Historically, however, the greatest road of them all was the 'Long Road', better known to us as the 'Silk Road'. Leading out from Peking in a south-westerly direction it passes through Sian-fu, the ancient capital of China, to Lanchow, Ansi, Qomul, Turfan, Kurla, Aucha, Agsu, Kashgar and so to western Turkestan. That portion of the road from Qomul to Yarkand still bears the name Tien-Shan-Nan-Lu, or the 'road south of the Celestial Mountains'; while the northern branch of this road which skirts the northern slopes of the Tien Shan from Qomul to Kulja and on to Khiva and Bokhara bears the name Tien-Shan-Pei-Lu, or the 'road north of the Celestial Mountains'.

Sven Hedin, who resurveyed the Silk Road at the behest of the Chinese Government, writes about this ancient highway as follows:

"The whole silk road from Sian via Anshi, Kashgar, Samarkand and Selencia to Tyre, is 4200 miles as the crow flies, and, including bends something like 6000 miles, or one-quarter of the length of the equator.

"It can be said without exaggeration that this traffic artery through the whole of the Old World is the longest and, from a cultural-historical standpoint, the most significant connecting link between peoples and continents that has ever existed on earth."

A road to the south-west branched from the 'Long Road' beyond Sian-fu and went through Chengtu in the rich Szechuan basin, thence through Yunnan and Bhamo to Teng-yueh, the treaty port on the Burmese border and so to the Irawadi. Regarding this road it has been said that

"from the difficulties it presents and the art and labor with which they have been overcome, does not appear to be inferior to the road over the Simplon."

China down to the end of the 18th Century was still to the front in road construction. Karlgren writes that

"European accounts of China during the 17th and 18th Centuries assert that material culture, agriculture, silk production, handicrafts in their great variety, the splendid roads, postal and canal systems, as well as administration and municipal enterprises, were at a height of excellence which put China in the foremost rank of countries of that day."

Adam Smith also wrote with reference to the executive maintenance of internal communications that

"particularly in China, where the highroads, and still more the navigable canals, it is pretended, exceed very much everything of the same kind which is known in Europe."

The once magnificent road system of ancient China has fallen into such derelict condition due to lack of maintenance that, with the ancient Chinese poet, "I gaze down the highway and my heart is sad within." The condition of the roads, more accurately than any other example, according to A. H. Smith, typifies the neglect of public affairs by the government and

the absence of public spirit among the people. Smith goes on to state that

"There are abundant evidences in various parts of the Empire that there once existed great Imperial highways connecting many of the most important cities, and that these highways were paved with stone and bordered with trees. The ruins of such roads are found not only in the neighborhood of Peking, but in such remote regions as Hunan and Szechuan. Vast sums must have been expended on their construction, and it would have been comparatively easy to keep them in repair, but this has been uniformly neglected, so that the ruins of such highways present serious impediments to travel, and the tracks have been abandoned from sheer necessity. It has been supposed that this decay of the great lines of traffic took place during the long period of disturbances before the close of the Ming Dynasty, and the beginning of the present Manchu line; but making all due allowance for political convulsions, a period of two hundred and fifty years is surely sufficiently long in which to restore the arteries of the Empire."

The deplorable state into which the roads of China have fallen is further stressed by Davies, who informs us that

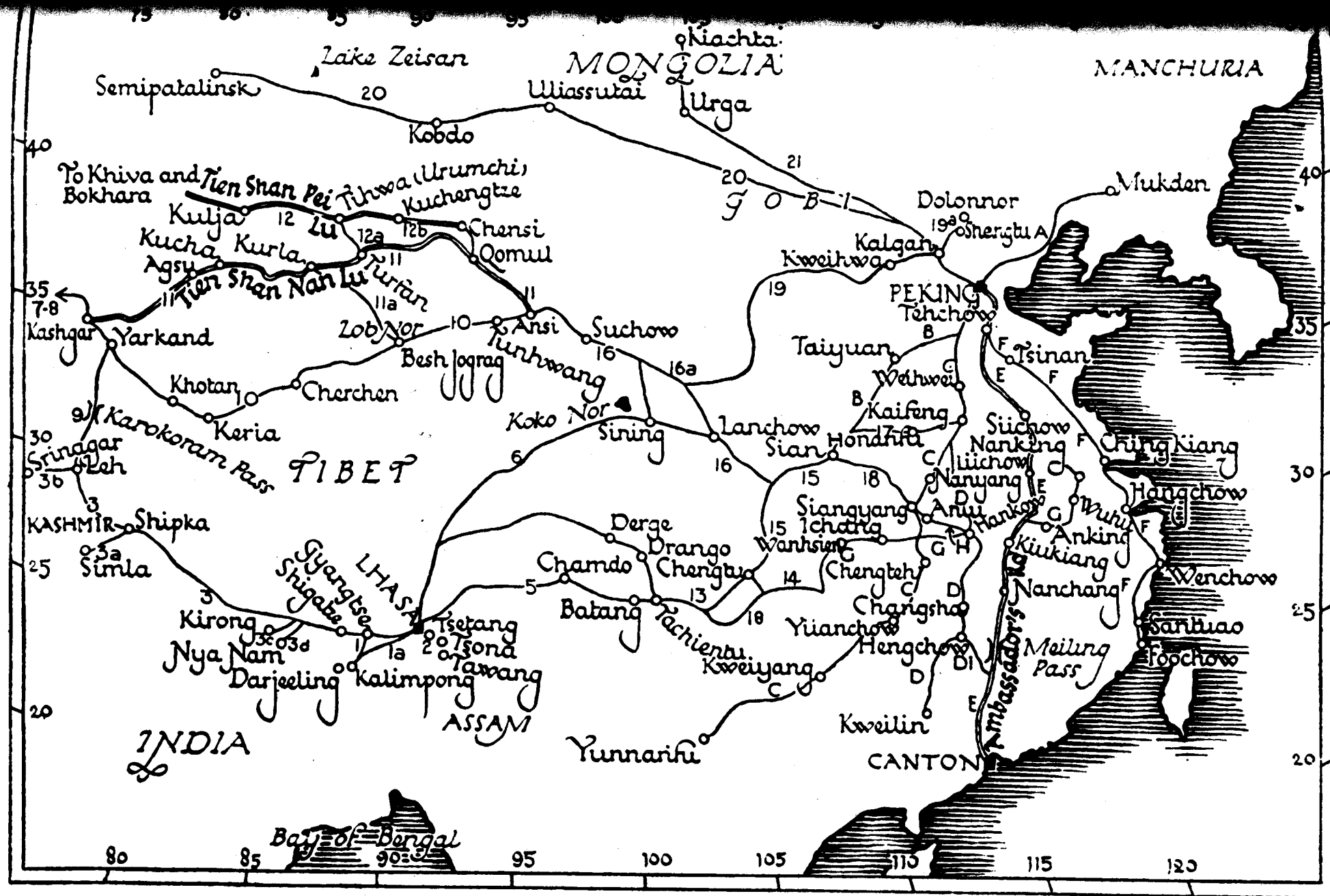
"the stones are of all shapes and sizes, with large spaces in between them, and the road seems specially designed to render both walking and riding equally unpleasant. Wherever it is possible to avoid the paved road, tracks have been made alongside of it, by which one can get along at a fair pace. These roads exist all over China, and I suppose the total length of them must run to some hundreds of thousands of miles."

Probably the most surprising roads to be encountered anywhere in the world are those in the loess country of the north China plain. Here the roads, in constant use through the centuries, have cut their way through the porous formation until they are hidden from sight at the bottom of canyons sometimes seventy and eighty feet below their original level. Poor people, otherwise homeless, have carved dwellings and stables out of the steep walls that line these sunken roads, consequently

It is quite startling to one's sense of mental balance to gaze out over the flat countryside, cultivated to a high degree of efficiency, and see neither roads, nor houses, nor people, nor domestic animals.

A man's head, apparently unattached and bobbing along over the wheat, resolves itself into a wholesome farmer riding in his cart over the sunken road; and the surprising fact that you pass under old gate-towers, whose foundations begin seven feet above your head, rather than through them in the prosaic manner, is quite in keeping with the unpredictable qualities of these roads.

Lethargy, the curse of modern China, seems at last to be crumbling under the threat of national oblivion. That this is so is exemplified by the gradual increase in road building, for never in the history of any people have the avenues of communication been possible without national unity, and conversely. That China has never lost the traditional art of road-building, though long dormant, is proven by the construction, entirely by hand, of a remarkable highway from Cheng-tu, the capital of Szechuan, through Yunnan to the Burma border, whence it goes onward to the coast of the Indian Ocean. This link with the outside world connects with the rebuilt 'Silk Road' and is in reality China's new 'life line'; for over it roll caravans, not of silk and its products of exchange, but truckloads of munitions and supplies with which to combat the inroads of conquest in her fight for survival.



Principal Roads

INDIA AND PERSIA

"These neither snow nor rain nor heat nor darkness of night prevent from accomplishing each one the task proposed to him, with the very utmost speed."

Couriers of the Persian Postal Service -
Herodotus.

INDIA AND PERSIA

It is now only as through a glass darkly that we are able to perceive the existence of a very highly advanced civilization in the remote period of ancient India. Archeologists have unearthed the remains of splendid cities which indicate an advancement parallel with that of the Sumerians and Elamites. Some authorities even are of the opinion that the Indus Valley produced the protoplasm of civilization spreading thence westward, first to Elam, then to Sumer and Akkad, and then to Egypt.

The physical condition of the lower valley of the Indus and its tributaries was similar to that of the Euphrates and the Nile. In all three, life demanded organized co-operation necessary to effectually control and direct the rivers against flood and drought, and in all three the uninterrupted flow of imports on a large scale was required to make life pleasant. Childe believes that

"Man's efforts to adjust himself to that environment and subdue it to his will accordingly culminated in the creation of an industrial and commercial urban civilization, but on a vaster scale than on the Nile or on the Euphrates."

Excavations by Marshall in the lower valley of the Indus disclosed a civilization reaching back to at least the third millenium B.C. Here were found houses, some of them two-storied, constructed of burnt brick and equipped with bathrooms and a very elaborate system of drainage. These people

were to a great extent occupied with trade and one of the modes of transportation was the two-wheeled cart. The foreign trade of India is as old as her history, for objects found in Sumeria and Egypt indicate a traffic between these countries and India as far back as 3000 B.C.

That intercourse in this section of the ancient world was not only effective but widespread is disclosed by the ruins at Mohenjo-daro on the Indus and Harappa on the Ravi. Four hundred miles separate these sites yet the civilization represented by each is astonishingly homogenous. Our surprise is augmented when we learn that identically the same civilization has been found at Amri, one hundred miles below Mohenjo-daro, and at Rupar on the Upper Sutlej, thereby greatly expanding the limits of intercourse.

The cities, according to Childe, were carefully laid out on a deliberate plan, and the plan was adhered to strictly during several phases of reconstruction so that the streets were always maintained at a constant width. Drainage was provided for by means of elaborate corbelled drains emptying into sumps.

Childe further states that

"The cities were inevitably centers of commerce and industry. Transport was facilitated by the use of two-wheeled carts (known from clay models). Trade was sufficiently well-organized to secure regular supplies not only of foodstuffs from the coasts but also metal from Baluchistan and Rajputana, of sank shell from Southern India, and of luxury articles from still further afield - lapis lazuli from Afghanistan or Persia, jade from China or Burma, amazonite from the Nilghary Hills of Kashmir. Indian materials such as pot-stone, and manufactures including seals and even knobbed pottery reached Babylonia during the first half of the third millennium. Conversely, Sumerian cylinder-seals and toilet

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sets were occasionally copied in India, and bitumen was used as a water-course."

That the use of the two-wheeled carts, such as have been found in city ruins, was widespread is proven by the fact that a model cart from Mehi in the Mashkai Valley shows that the hillsmen used wheeled vehicles similar to those in use in Mohenjo-daro.

Coming down to a later period in India's history, we find that Chandragupta, who freed India from Macedonian authority established by Alexander in 326 B.C., separated the duties of government so as to function under various departments. One of these, according to Durant, was the Department of Communications which

"built and repaired roads throughout the empire, from the narrow wagon-tracks of the villages to trade routes thirty-two feet, and royal roads sixty-four feet, wide. One of these imperial highways extended twelve hundred miles from Pataliputra to the northwestern frontier."

Megasthenes, the Greek Ambassador from Seleucus Nicator, King of Syria, states that these roads were marked with pillars at approximately every mile upon which were marked directions and distances to various destinations. Shade trees, wells, police stations and inns were provided at regular intervals along the route.

Indian archeology, although in its infancy, seems to justify the prediction that a brilliant future is in store for it. The extent of the road system and the method of construction is, of course, at this time indeterminate, but that roads did exist and that they were built and maintained in a systematic manner is unquestionable due to the very early use of wheeled

vehicles for the transport of goods, the widespread exchange of a great volume and varied type of commodities, and the movement of goods to, from and through, countries whose topography is such that wheeled vehicles could not have been used as extensively as they were, if at all, without well-made roads over which to travel.

Persia, recognized by all authorities as a builder of roads, displayed considerable ingenuity in the improvement of transport and communications, much more so than in industry. The empire, extending from the AEgean to the Indus River and from the Caspian to the Indian Ocean, was interlaced with a magnificent system of highways. In order to unite and efficiently control his widespread empire, Darius I (521-485 B.C.) instructed his engineers to construct great roads between the various capitals, and over these excellent roads was maintained a government-controlled postal service such as had not heretofore existed on so vast a scale.

The Persians inherited from the Babylonians and Assyrians a considerable network of great roads over which traffic had flowed for thousands of years regardless of the rise and fall of great empires. The most famous of these was the Royal Road which ran from Susa, the capital of Persia, through Arbela, Guagamela, Nineveh, Amida, Comana, Ancyra, Gordium, and Sardis to Ephesus. Although this road is called the Ancient Royal Road of the Persians, it was already ancient long before the Persians gained control over it. That this road was a noteworthy piece of work is evidenced by the attention given to it

by Herodotus, who has this to say about it:

"With respect to this road, the case is as follows: There are royal stations all along, and excellent inns, and the whole road is through an inhabited and safe country. There are 20 stations extending through Lydia and Phrygia, and the distance is 94 parasangs and a half. After Phrygia, the river Halys is met with, at which there are gates, through which it is absolutely necessary to pass and thus to cross the river: there is also a considerable fort on it. When you cross over into Cappadocia, and traverse that country to the border of Cilicia, there are eight and twenty stations, and 104 parasangs; and on the borders of these people you go through two gates, and pass by two forts. When you have gone through these and made the journey through Cilicia, there are three stations and 15 parasangs and a half. In Armenia there are 15 stations for resting places, and 56 parasangs and a half. As you enter from Armenia into the country of Matiene, there are four stations; and from thence as you proceed to the Cissian territory there are 11 stations, and 42 parasangs and a half to the river Choaspes, on this Susa is built. Now if the royal road has been correctly measured in parasangs, and if the parasang is equal to 30 stades, as indeed it is, from Sardis to the royal palace is a distance of 13,500 stades (1550 miles), the parasangs being 450; and by those who travel 150 stades (17½ miles) every day, just 90 days are spent on the journey."

Although ordinary travel required 90 days to traverse this distance, it is said that dispatches were sometimes carried its whole length in six days.

Wheeler vividly portrays this great highway as follows:

"All the diverse life of the countries it traversed was drawn into its paths. Carians and Cilicians, Phrygians and Cappadocians, staid Lydians, sociable Greeks, crafty Armenians, rude traders from the Euxine shores, nabobs of Babylon, Medes and Persians, galloping couriers mounted on their Bokhara ponies or fine Arab steeds, envoys with train and state, peasants driving their donkeys laden with skins of oil or wine or sacks of grain, stately caravans bearing the wares and the fabrics of the south to exchange for the metals, slaves and grain of the north, travelers and traders seeking to know and exploit the world, - all were there, and all were safe under the protection of an empire, the roadway of which pierced the strata of many tribes and many cultures, and helped set the world amixing."

Numerous references attest to the ability of the Persians

as bridge builders. One structure in particular, although strictly military in purpose, stands out because of the very audacity of the attempt and because of the engineering skill required to safely provide for the crossing over of great numbers of men and beasts and the accompanying tons of supplies and equipment. These bridges, for there were two of them, constructed by Xerxes, crossed the Hellespont from Abydos to the opposite shore, a distance of seven stades or 4247 feet. The two had no more than been completed when a violent storm destroyed them completely, the second attempt, however, was successful. The bridges, according to Herodotus, were constructed by means of penteconters and triremes, 360 and 314 in each bridge respectively, deeply anchored as a protection against the swift current and the winds, and securely fastened together from shore to shore by great cables, twisted together out of two smaller white flax and four papyrus cables. Tree trunks cut to the width of the bridge were then laid in regular order upon these cables and fastened together. Next in order followed a layer of brush-wood and finally an earthen roadway firmly tamped in place. Both bridges began on the Asiatic side close together, but were a considerable distance apart on the European side, since the first, nearest the AEgean, spanned the strait in a direct line while the second and longer one went in an oblique direction up the strait toward the Propontis. According to Rogers, the crossing was made in early June 480 B.C. without mishaps, the troops passing by one bridge, and the baggage trains by the other. This immense host, estimated

by Herodotus to number 1,800,000 took seven days and nights in which to make the crossing, and Xerxes, the better to witness this splendid spectacle, had a marble throne erected on a hill near Abydos.

Susa, the fabulous capital of Persia, was famous thousands of years before the Persian Empire came into being. Here archeologists found human remains dating back 20,000 years and evidence of an advanced culture as old as 4500 B. C. At the beginning of its authentic history, Susa appears as a place of great renown. As the capital of Elam, it not only was a contemporary, but possibly was also a predecessor of the ancient cities of Chaldea. The annals of Assur-bani-pal inform us that the king of Elam invaded Babylon more than 2000 B.C. and carried away the sacred images from Uruk as trophies of his victory. From time immemorial Susa appears to have acted as a clearance house for the wealth of India. Strategically situated as it was at the head of the trade routes which connected the Iranian plateau with the lower valley of the Tigris and the Euphrates Rivers and the Persian Gulf, trade was ever a component part of its high culture. As early as 4500 B.C. this culture included copper weapons and tools, cultivated grains, domesticated animals, hieroglyphic writing, and business documents. The discovery here of the oldest known wagon wheel not only bears out the highly developed state of advancement, but also is proof of a very early extensive trade which extended from India at one extreme to Egypt on the other. That the Elamites had perfected wheeled vehicles for practical purposes of transport, and that they were evidently highly prized even down to

the Assyrian period when the war chariot was already a specialized arm of attack, is apparent from an inscription by Esarhaddon relating how he tore down the ruins and then rebuilt the palace of his grandfather, Sennacherib, stating therein that

"In order to build that harem the people of my land hauled its bricks in wagons of Elam which I had carried away as spoil by the command of the gods."

Persia's last period of greatness was under the Sasanian monarchs who ruled from 226 to 642 A.D. This dynasty, like the earlier ones realized the vital importance of roads and there is still to be found in every part of Persia roads built by these progressive rulers. Wilson tells us that

"long stretches are to be found in every part of the Zagros range from latitude 36 degrees to Bandar Abbas and beyond, and in Gilan, Mazanderan and the Elburz range. Almost every important valley and gorge in the Luristan, Bakhtiari and Kuhgalu hills and in Fars has its Sasanian road, heavily paved with water-worn boulders, winding up hillsides at a steady gradient."

Bridges also were commonplace and were comparable with those built by the Romans. Constructed of finely worked stone, laid with a lime mortar whose resistance to weathering surpassed that of the stone, these bridges, of quite generous scale, had broad, flat approaches which suggested the movement of heavy traffic. Remains of these bridges are still to be found in various sections of the country.

Further information concerning the roads during this period is given by Wilson as follows:

"The Sasanian monarchs built a network of paved roads from south to north and from east to west, bridging the great rivers and ravines, and erecting caravan-sarais and toll-gates. There is no part of the Zagros

from Khanaqin to Isfahan and Shiraz in which traces of these ancient roads cannot be found, running up hill and down dale like the Roman roads in England, zig-zagging up precipitous slopes, and cutting into the solid rock where necessary. The extension of central authority over great areas and the construction of these substantial roads and bridges, which are far more numerous than the needs of trade can ever have demanded, may well have given an economic impetus to nomad life, and it is probably during this period that the habit of long tribal migrations of 200 to 300 miles first took root. The Arabs, when they conquered Persia in the seventh-ninth centuries, far excelled their predecessors in the size and magnificence of their bridges, many of which remain almost intact to this day; they do not appear to have done much to the roads, but there can be little doubt that they sought to keep them open to trade, and that they were still extensively used."

THE AEGEAN CIVILIZATION

"And even as a man right well skilled in horsemanship that couples four horses out of many, and hurrying them from the plain towards a great city, drives along the public way."

Iliad - Homer

THE AEGEAN CIVILIZATION

All of the glory, the splendour, the mighty feats of valour embraced in the pageantry of Greek Mythology and made to stride heroically across the stage of life by the giants of Grecian literature has been focused upon the retina of history, always with the sea as a background, to such an extent that it has cast a shadow over the humbler avenue of transport for the control of which man used the sea only as a means to the end that he might march over these roads into such magnificent cities of antiquity as Troy, Mycenae, and Knossos.

Troy, already a center of power as early as 3000 B.C., was not one city but nine, each one rising phoenix-like from its own ashes. The mighty city of King Priam, made famous to us by Homer and Vergil, was but Troy VI whose date, according to both tradition and archeological finds, is set at from 1500-1000 B.C. One thousand years before this was "the burned city", Troy II (2500-2000 B.C.), whose power and wealth were consumed in a fearful holocaust.

The rulers of Troy were wealthy commercial kings and Breasted believes that one cause of the city's prosperity was probably the importation of tin from the Danube and the development of a bronze industry. The indisputable evidence of an extensive trade points to the existence of well made roads, definite proof of which is given by Homer who mentions the "carriage roads" in the neighborhood of Troy.

That these roads did exist is conclusively proven by Schliemann who brought to light portions of roads of massive construction. Quoting excerpts from his works, we learn that

"The excavations made in 1873 show that ancient Troy was destroyed by a fearful conflagration. How great the heat must have been is clear also from the large slabs of stone upon the road leading from the double Scaean Gate down to the plain; for when I laid this road open, all the slabs appeared as uninjured as if they had been put down quite recently; but after they had been exposed to the air for a few days, the slabs of the upper part of the road, to the extent of some ten feet, which had been exposed to the heat, began to crumble away, while those of the lower portion of the road, which had not been touched by the fire, have remained uninjured, and seem to be indestructable."

Schliemann goes on to say that

"I have brought many wonderful things to light, among which I may especially mention a street of the Pergamus. It is $17\frac{1}{4}$ feet broad, and is paved with stone flags from $4\frac{1}{4}$ to 5 feet long, and from 35 inches to $4\frac{1}{2}$ feet broad. It runs down very abruptly in a south-western direction from the Great Tower of Ilium towards the Plain."

Homer, according to this authority, could never have seen Ancient Troy since it lay buried deep in heaps of rubbish, yet he did have considerable knowledge of it from hearsay, because the tragic fate of the famous city was at his time still fresh to the memory, and the street excavated by Schliemann is mentioned by Homer in Iliad:

"So spoke the ancient dame; and Hector straight
Through the wide street his rapid steps retraced.
But when at last the mighty city's length
Was traversed, and the Scaean Gates were reached,
Whence was the outlet to the plain -"

That Troy II carried on an extensive commerce with distant countries is evidenced by the discoveries of articles made of gold, silver, bronze, lapis lazuli, rock crystal, jade and

amber; indicating that trading relations were carried on with both Europe and Asia Minor. J. L. Myres states that one land route went south through Mysia, Maeonia to Lykia, then skirting the central plateau of Asia Minor through Pisidia and Cilicia, it went on to Cyprus, the copper island. The close trade relations between Cyprus and Troy, according to Ormerod, must have been maintained by connecting valley roads, while Sartiaux says regarding the Phrygians that "Their products came to Troy overland, along the roads of the Sangarius, the Rhyndacos and the Macestos." Another evidence of the use of the roads is the identity of culture between the Trojan civilization and that of Bos-Oyuk in Phrygia and Yortan in Mysia.

Mycenae, once the principal city of Greece, was famous not only as the capital of Agamemnon and for its wealth and splendour, but according to Homer, it was famous also as the city "of the broad ways", a statement which was equally applicable to the surrounding towns for between the separate villages ran wide connecting roads. Founded by Perseus in 1457 B.C. and destroyed by the inhabitants of Argos in 468 B.C., nothing now remains but its magnificent ruins.

The broad road within the acropolis was in part a carriage road, regarding which Tsountas states that

"It started at the Lion's Gate, and winding first south and then east, at a steep grade, ended at the foot of the ascent to the palace. The first section is over sixteen feet broad and is, as far as now preserved, entirely artificial, being composed of four successive layers, first of stones and earth, second of large stones, third of pebbles, and finally of earth. This roadbed is supported on the right as one ascends, where the ground slopes away precipitously, by a Cyclopean wall. This made section of the road lay originally

outside of the acropolis, to which it served as an ascent. When afterwards included in the acropolis, it formed an extension of a longer road, which ran through the lower town from Makry Lithari to the Lion's Gate."

Traces of these roads were found by Steffen in 1884. According to Glotz, the roads climb gradients without diverging; are cut into the solid rock, the outer edge of the road being reinforced by stone retaining walls; and cross torrents by bridges consisting of a "Gothic Arch" with a great slab for a lintel.

Regarding the extent of the road system itself and a more detailed description of the type of construction, we are again indebted to Tsountas, who tells us that the fortress-city required not only internal but external means of communication, and

"We find in fact a network of Cyclopean highways in the main binding together Mycenae and Corinth.

"One of these highways, starting apparently from the gate near Makry Lithari, led a short distance to the south, and there crossing the Chavos by a Cyclopean bridge, half of which still remains, continued on to the Heraion, some three miles distant. (This was the sacred way to the National Sanctuary.) The Lion's Gate was the starting point of three other roads. Of these the first ran north-west to the bed of the Cephissus, where it forked - the left branch probably leading to Nemea and Phlius, and the right to Cleonae and Corinth; the second was the short cut across the mountains to Cleonae, whence it also went on to Corinth, the third and easternmost - again a mountain road to Corinth - passed through the district of Tenea near the hamlets Hagionori, Kleniae, and Chiliomodi. These roads are 12 or 13 feet wide, and along the mountain sides they are cut in the rock or supported by Cyclopean masonry, with frequent cross-drains (every two paces) to carry off the rainfall. The mountain rills and ravines were bridged with the same Cyclopean masonry which prevailed in the fortress walls, the courses converging to form the pointed arch, and being finally covered by a single block. As a single span of this construction afforded but a narrow water-course, we usually find several channels left through the bottom course of masonry to relieve the pressure on the main opening. The three different roads to Corinth witness the great and prime

importance which the Mycenaens attached to easy communication with that city."

Crete, the birthplace of Zeus, the home of the Minotaur, and the locale of many of the adventures of gods and heroes of Greek mythology was, according to Homer, an island of a hundred cities. Well made roads connected these cities and uninterrupted communications was maintained by a well-organized roads department. Carefully built roads, kept in good repair, were paved with cobbles or flags of gypsum and had footpaths and gutters along the sides. Horses and chariots were known from the 16th century B.C., and ox-drawn wagons were in use in the Middle Minoan Period (2100-1580 B.C.).

The port of Komo, facing Egypt on the south, and Knossos, the capital in the north, were connected by a paved road 40 miles in length, which traversed the mountainous section of the island. Evans, who discovered this road connecting the two important cities, states that it was no small achievement to have built a road fit for wheeled traffic across the mountain backbone of a large and rugged island. Not a track, but a very fine example of bronze-age engineering, the road was provided with culverts and viaducts, while above and below these sections of the road cut into the hillsides, were Cyclopean terrace walls.

At Knossos, forty miles distant from Komo, the road led up to the palace of the kings by way of a viaduct along the hillside and a bridge that spanned a tributary ravine. Here the road forked, one leading to the arsenal and the other to the port, $3\frac{1}{2}$ miles away.

Evans, while excavating a petrified mass of earth near the

palace which was thought to be the road itself, brought to light eight courses, forming the piers of a viaduct, for a length of 21 meters. Foundations of unhewn stone, from 20 to 25 centimeters in thickness, and covered with a thick layer of concrete, were also found. This road was about 12 feet wide and on either side of the paved center strip there was built a walkway of rammed pebbles, clay and potsherds.

Baikie, in referring to the section of the road found near the palace of Knosses, tells us that

"It was overlaid by a Roman roadway, and an interesting comparison was thus made possible between the Minoan work and that of the great road-makers of later days. The Roman road came out rather badly from the comparison, the earlier construction being superior in every respect."

OTHER PRE-ROMAN ROADS

"The voice of him that crieth in the wilderness, prepare ye the way of the Lord, make straight in the desert a highway for our God. Every valley shall be exalted, and every mountain and hill shall be made low: and the crooked shall be made straight and the rough places plain."

Isaiah 40: 3-4

OTHER PRE-ROMAN ROADS

7

Palestine - "the door of the nations" -, Syria, and Phoenicia are so situated geographically that they have been from time immemorial, collectively speaking, the highway over which the ancient civilizations marched in endless processions, never pausing long enough to create or permit the creation of an individualistic civilization of its own, interested only in keeping open the lanes of traffic for troops and trade. A battlefield through the centuries, this part of the ancient world was so frequently the bone of contention for the snarling dogs of War, that it never really had time enough between conquests to develop a unified civilization of its own. Yet withal, the learning, the religion, the commerce by which we live today never ceased to flow over the roads which traversed this land and bridged the gap between the cultures of Egypt and Mesopotamia.

The word 'road' is not mentioned, as such, in the Bible, but we find numerous references to the words 'way' and 'highway'. The allegorical sense in which this term is used proves that made roads were commonplace.

Road construction is mentioned early in the Bible, for in Deuteronomy 19:3, Moses, having selected six cities of refuge, issued instructions that roads should be built to each one, for he expressly states that

"Thou shalt prepare thee a way."

Crudens states that

"These cities were to be easy of access, and to have smooth and good roads to them, and bridges where there should be occasion; where there were any cross-roads, they took care to set up posts with an inscription, directing the way to the City of Refuge."

Isaiah especially uses the word 'way' with familiarity, for

we read in 35:8 that:

"And a highway shall be there, and a way, and it shall be called the way of holiness -"

Embankments were known to him for in 57:14 we read:

"And shall say, cast ye up, cast ye up, prepare the way, take up the stumbling block out of the way of my people."

A raised highway is again mentioned by Isaiah in 62:10 where he warns,

"Prepare ye the way of the people; cast up, cast up the highway; gather out the stones; lift up a standard to the people."

That Jeremiah is familiar with this type of road is brought out in 18:15 where he tells us that

"they have caused them to stumble in their ways from the ancient paths, in a way not cast up."

Substructures in roads were evidently known to Job for he questions in 22:15-16:

"Hast thou marked the old way which wicked men have trodden? Which were cut down out of time, whose foundation was overflowed with a flood."

Heavy traffic over the roads was a familiar sight for we read in Nahum 2:4 that

"The chariots shall rage in the streets, they shall jostle one another in the broad ways."

Even disruption of traffic over the main thoroughfares is cited in Judges 5:6 for we learn that

"In the days of Shamgar the son of Anath in the days of Jael, the highways were unoccupied, and the travelers walked through byways."

All of these references, used purely in a religious sense, certainly indicate that road construction was something so long practiced and so excellently performed that it could be used as a criterion in such a vital subject as the religion of a people whose very existence, as a race, was inflexibly bound up with their belief in one and only one supreme being, Jehovah.

Numerous roads of Roman construction have been found throughout this region, but here as elsewhere Rome used what was already there. The unending flow of trade moved relentlessly forward. Contesting armies vied for control of this land bridge between civilizations, but it mattered not whether the conqueror of the moment was Egyptian, Assyrian, Babylonian or Hittite, the continuity of commerce went forward unabated, for the conqueror and the conquered alike realized the vital importance of keeping the trade routes open.

References to paved roads is very meagre, but they did exist for Josephus tells us that

"Solomon, exercising a divine thoughtfulness and zeal in all things and being an ardent lover of beauty, did not neglect the roads either, but those leading to Jerusalem, which was the royal city, he paved with black stone, both for the convenience of wayfarers and in order to show the greatness of his wealth and power."

An inscription by the Moabite King Mesha, according to Gregory, refers to his having made a road along the Arnon and his contemporary Ahab (ca 897 B.C.), famous as the husband of Jezebel, did the same, probably, on the other side of the Jordan. We

know that paved roads were built in the vicinity of Lachish, the ancient Amorite city of Judah, for a detail from one of the friezes in the palace of Sennacherib portrays several sections of a paved road upon which the Assyrian warriors advanced to assault the fortress. The roads are paved with large, thick slabs of squared stone and are placed in three distinct layers. One interesting feature of this scene is that each group of soldiers is preceded by an enclosed, four-wheeled fighting machine, which might well be considered the ancestor of the modern tank. Lachish was evidently an important city for untold centuries for the ruins consist of seven distinct strata, each one the remains of an entire city.

Most of the cities possessed paved streets, this we know from authentic records as well as from actual remains. Damascus had its famous mile-long 'street called Straight', lined with four rows of white marble Corinthian columns. The middle section was roofed over and was used exclusively by pedestrians, while the two outer ones were open to the sky and were used for traffic. Palmyra had a street nearly as famous, of the same length, and lined in the same manner with huge columns. Gaza, always important to Egypt and her enemies, was paved and here has been found, in mosaic, one of the few existing maps of antiquity. Petra - "a red-rose city half as old as Time" - was entered by a paved road. Burckhardt, during his exploration in 1812, entered the valley by a roadway paved with stone blocks. The two islands which composed Tyre were connected by a causeway and these in turn were joined with the surrounding

reefs by the same method. Strange to say, it was not by an attack from the sea that Tyre fell, but by land, for it was not until a causeway had been built from the mainland to Tyre that Alexander was able at last to conquer this famous stronghold of commerce.

The first attempt to join the island and the mainland met with failure due to the mistake in projecting it across the strait perpendicular to the run of the channel. The strong current and wave action, assisted by the Phoenicians who sent huge fire ships against the towers and siege works, so thoroughly destroyed the causeway that Alexander, upon his return from an expedition against the Arabs, found scarcely any traces remaining. Construction of this first causeway, 200 feet wide, was begun by driving piles into the soft mud from the mainland seawards. Upon these piles were cast brush, trees, stones, earth, and whatever other material was procurable. Nothing daunted by failure of this first attempt, Alexander began construction on a new causeway, broader even than the first one, but at an angle to the north-east so as to minimize the force of the current and wave action. The second attempt proved successful and Tyre fell, but not without considerable losses, for the battle was contested stubbornly to the very end.

Exceptionally well built roads must of necessity have existed throughout this section of the ancient world for here, as elsewhere, were built structures out of such massive materials that only over good roads could they possibly have been transported. Baalbek, just north of Damascus, had for

centuries before the birth of Christ been a holy place in Syria dedicated to the worship of Baal. The platform upon which her temples stand is supported by a wall into which have been laid five tremendous blocks of stone. Three of these, placed nineteen feet above ground level, measure 65' x 14'6" x 12', 64'10" x 14'6" x 12', and 63'2" x 14'6" x 12', respectively. One block, larger even than these, measuring 69' x 16' x 13'6", and weighing approximately 1000 tons, has been found in a quarry outside of Baalbek, left there for some unaccountable reason after it had been extracted by the masons.

Solomon most certainly had need of good roads in order to transport the enormous quantity of building materials for his magnificent temple, palace and other structures. Not only were roads necessary to bring these materials down from the mountains and over great distances to Jerusalem, but they must needs be well made in order that no damage be inflicted on the finished product in transit, for the temple

"when it was in building, was built of stone made ready before it was brought thither: so there was neither hammer nor ax nor any tool of iron heard in the house, while it was in building."

Here again we have undeniable proof that the ancients must have known and consistently practiced the art of road construction for in no case is any but the finished product brought to the site of erection, whether it be dressed building stone or massive statues.

One of the most interesting ruins in Jerusalem consists of the remains of a colossal archway located near the south-west corner of the Haram. Three courses of massive masonry, one of

them five feet four inches in height, project from the western wall and have been identified with the famous causeway which connected Moriah and Zion. Two of the stones measure 24 feet and 20 feet in length and the other ones in proportion. Calculations based on that portion of the curve still intact indicate that this one arch had a span of 40 feet. Foundations of piers brought to light by excavations indicate that a series of such arches bridged the Tyropean Valley which at this place, according to Robinson, is 350 feet across. Josephus mentions this causeway as being in existence in the time of Christ, yet a voussoir cut to a different radius has been found nearby, buried under 75 feet of debris, which would prove that the valley had previously been spanned by a much older causeway. The character and Cyclopean dimensions of these stones lead one to assume that they might date back even to the reign of Solomon for in I Kings 7:10 we read that the foundations of the buildings were of

"costly stone, even great stones, stones of ten cubits (17 feet), and stones of eight cubits ($13\frac{1}{2}$ feet)."

Although no direct proof has as yet been presented, there is a possibility that this causeway is the one referred to in I Chronicles 26:16 as

"the causeway of the going up."

According to I Kings 10:5 and II Chronicles 9:4, it might be this causeway, along with other wondrous sights, which left the Queen of Sheba awed to the point of humility for we read that

"when the queen of Sheba had seen the wisdom of Solomon, and the house that he had built - - - and his ascent by which he went up into the house

of the Lord; there was no more spirit in her."

Many roads traverse this section of the ancient world in every direction, and although they are referred to in many Babylonian, Assyrian and Egyptian records, they are more familiar to us by their Biblical names. The erroneous interpretation of the word 'way' has caused the average reader of the Bible to consider it in the sense of direction rather than as a road, but the Hebrew word 'derekh', translated 'way', means a 'road', a 'beaten track', a 'trodden course'; and in several instances it is actually translated as 'highway' or 'king's highway'. This latter translation we find in Numbers 20:19:

"And the children of Israel said unto him (King of Edom), we will go by the highway."

The principal roads were the Philistine Road, the Wall Road (Way of Shur), the Red Sea Road, the Mount Seir Road, the Amorite-Hill-country Road, the 'Arabah Road, the Edom Royal Road, the Moab Wilderness Road, and the Bashan Road.

These routes have varied but slightly down through the centuries, and their ability to withstand the destruction of time is most forcibly depicted in the statement of B. H. Carroll regarding the great coast road, or the Way of the Philistines, which led northward out of Egypt along the coast of the Mediterranean, crossed Palestine, and went on to Assyria, Babylon and India.

"Babylon is a ruin, a stately and solitary group of palms marks where Memphis stood, jackals slake their thirst in the waters of the sacred lake by the hall of a thousand columns at Thebes, but the road that formed the nexus between these vanished civilizations remains after the winds of four milleniums have sighed themselves to silence over the graves of its forgotten architects and engineers."

CARTHAGE

Carthage, one of the most powerful and certainly one of the wealthiest cities of antiquity, has, because of the pitiful lack of accurate information, been confined to the realm of the neo-mythical. It is indeed tragic that so little can be learned of a people who, although strictly commercial and with little inclination for war, successfully withstood the onslaughts of one of the most powerful empires of history for a long period of time.

Scipio, having conquered the city, inquired of Rome what to do with it. In no mood for leniency towards an enemy who had so persistently flouted her power and who had threatened her existence as none other had, Rome's answer was "Curse it!" The malediction was evidently anything but pusilanimous for it is still referred to locally as the 'Curse of Scipio'. Captured in 146 B.C., the city was fired with such deliberate cunning that for 16 days the holocaust raged and in the end nothing but dead ashes remained of one of the most fabulous cities in history.

Dependent as Carthage was upon the sea for its existence, it could never have withstood the continued drain upon its resources by both Greeks and Romans but for an internal system of communications. Without a highly developed system of roads throughout her possessions she could never have reached or maintained the heights attained, either in commerce or war.

The Carthaginians are generally credited with instructing the Romans in the art of road building. Isidorus, who quotes

verbatim from Servius, tells us that

"The Carthaginians are said to have been the first to pave roads with stone: afterwards the Romans laid them out over almost the whole world, for directness of journeys, and to prevent the populace being workless."

It is doubtful that either Servius or Isidorus would have given the Carthaginians preeminent credit as road builders, rather than the Romans, without definite evidence which we do not now possess.

The once splendid roads of Carthage are either lost in the sands of the desert or were taken over by Rome and are therefore considered as Roman in origin. Near the ancient ruins of Carthage there has been found a few traces of a double road leading to Tunis and of another road leading to Camarat. Ryves tells us that

"Some of the roads of Spain are very well engineered, as for instance, parts of the great Phoenician road leading from Cartagena to the Pyrenees and France."

Munro informs us that of three known pre-Roman roads in Spain, of which no trace now remains, one was built along the coast near Tarragona, one between Astorga and Broga, and one near Cadiz. Bou Kornein, along the Imperial Way south from Carthage, was the 'high place' of the Canaanites, long sacred as a place of worship to Baal, and still farther south, at Saigu, are the ruins of another temple dedicated to Baal. The importance of these sites as religious centers indicates the existence of a well-made highway many years before it became known as a Roman road. Also in the vicinity of this road is Djebel Resses, the lead mountain, which was extensively worked by the Carthaginians.

All of the magnificent cities of Phoenician Africa were undoubtedly connected with excellent roads which to us must unfortunately remain Roman in origin until Truth, long buried under the ruins of Roman conquest, is brought to light, if ever, by the patient probing of archeologists. We have such meagre evidence, either actual or literary, as to the splendid system of stone paved roads which the Carthaginians are credited with having established as early as the 5th century B.C., that with Sallust we had best repeat,

"I say nothing about Carthage, for I think it better to say nothing about her than to say too little."

ROMAN ROADS

"Seafaring and agriculture, fortification, law, weapons, roadmaking, clothing and all else belonging to it, all the prizes and all the luxuries of life, music, painting, and the shaping of cunning statues - all these experience taught to men as they advanced slowly step by step - experience and the adventures of man's tireless mind."

Primitive Man - Lucretius

ROMAN ROADS

Rome sat on her seven hills and by her roads controlled the destinies of an empire. Because she was the last of the many powerful empires of antiquity and we are therefore closer to her than to any of the others in point of kinship; because classically we have been taught to sit at her footstool; because Rome still is and the European provinces that were once hers have these many years been powerful states in their own right; we have not only a greater amount of documentary evidence concerning her road system, but we have also innumerable remains of the roads which she built throughout the vast extent of her empire.

The Romans, whose empire was greater than any other known to antiquity, conquered it by military prowess, secured it by engineering ability, and maintained it by legal acumen. Without roads there would have been no Roman Empire. The roads, like so many other of her claims to fame, were already an accomplished fact many centuries prior to her rise to power, yet eulogy, if ever justified, was deserved by the Roman system of communications, with its web of roads in and around the entire Empire. Although good roads had long existed in Europe, as well as in Asia and Africa, no unified system had ever been perfected such as was established under the Republic and completed under the Empire. Chapot says that

"The whole organization was the product of great guiding ideas, and the main roads were truly conceived and constructed as international highways."

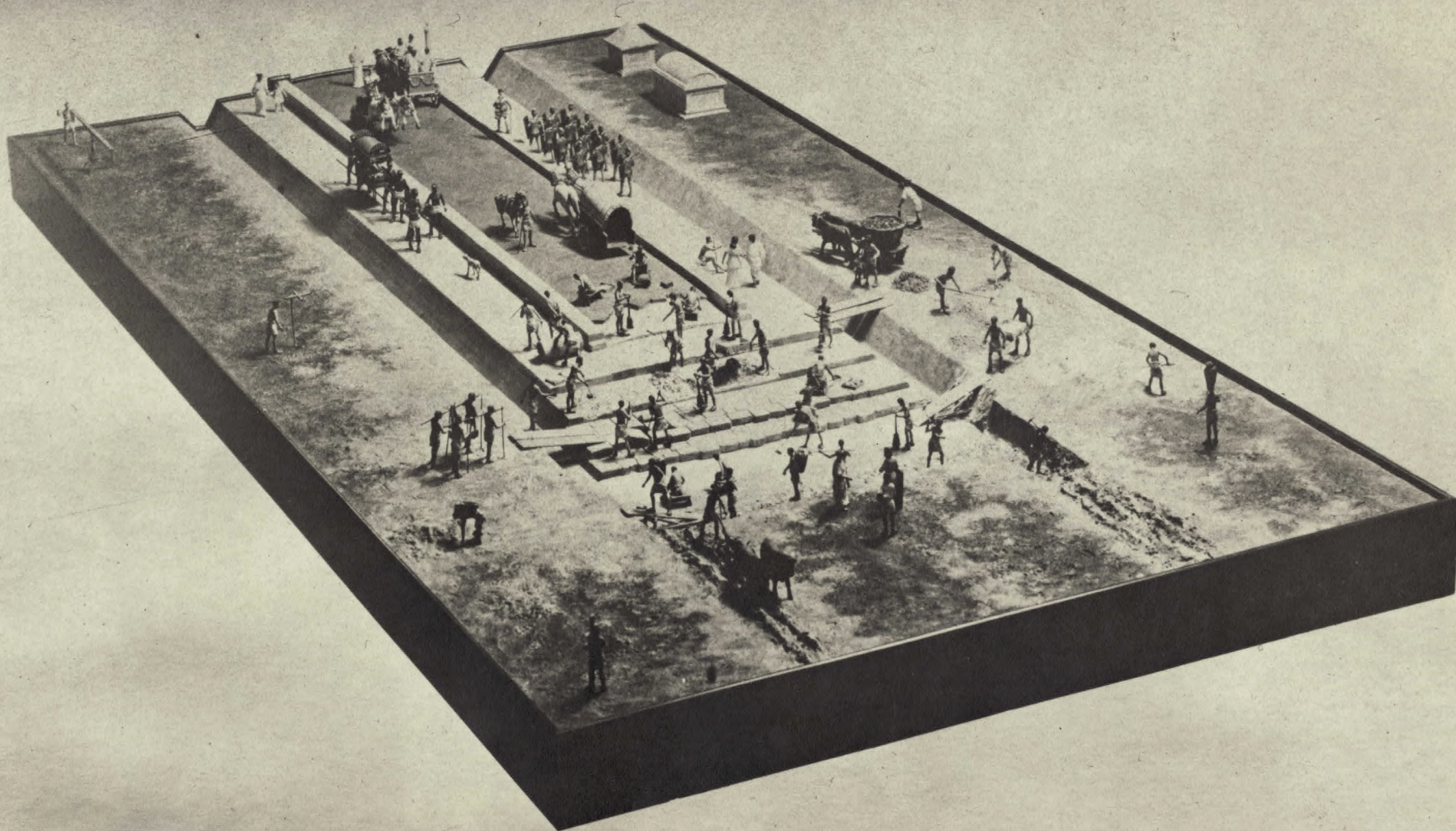
The actual extent of the road system is unknown to us, and in all probability will not be discovered, for none of the Itineraries that has been preserved gives a complete idea concerning it. The Itinerary of Antonine (150 A.D.) lists 372 main roads with a total length of 53,658 Roman miles or 52,016 English miles which includes only the military highways connecting Rome with the provinces and large cities. The mileage included within the various provinces was as follows:

Italy	13,024 Roman miles
Gaul	9,320
Great Britain	2,579
Spain	7,700
Africa	9,348
Egypt	1,500
Asia	8,500
Sicily	1,362
Sardinia	200
Corsica	125
Total	53,658

The main roads, known as military roads, were built, maintained and owned by the State. In Italy proper they were originally made by censors, in the provinces by the emperors or provincial governors; in either case, the road generally bore the name of its maker. During the reign of Augustus complete control over the roads was lessened to the extent that commissioners were designated to superintend the work and repairs were performed by contractors. Secondary or parish roads, which

connected the less important towns and districts with the main highways, were controlled by local magistrates and repaired by the landowners. The minor roads consisted of farm roads which served as feeders to the main and secondary roads, private roads which were made and maintained at private expense, and a considerable number of mule paths.

The Roman roads, like all of their predecessors, were of massive construction and, wherever possible, local building material was used. The overall width of the main roads varied from 16 to 30 feet which provided for an effective travel-way of from 12 to 16 feet, while the width of the side roads, built on both sides of the central roadway, varied from 6 to 8 feet. Three or four courses, laid to a depth of from three to four feet, was the usual type of construction. Since the Roman engineers believed that the foundation, rather than the wearing surface, was the controlling factor, the first course was nearly always built of large, flat stones, either field or quarry, laid on the sub-grade. In the event a marshy terrain was to be crossed, this course was preceded by one consisting of piles, logs, brush, or even oak planks covered with a bed of rushes, reeds or straw. The second and third courses, depending upon the availability of suitable material and the importance of the road, consisted of broken stone, placed dry or mixed with mortar; clay-gravel, either natural or mixed; broken bricks, tiles, and similar materials; or earth. The wearing course generally consisted of undressed stones or cobblestones, gravel, clay-gravel, or sand-clay, but on the more important



33-326 - Photograph of model of the Appian Way, built by Public Roads Administration

roads it consisted of dressed, close-fitting, polygonal blocks of stone irregular in size. Were we to reproduce these roads today the cost per mile for the average military road would be \$116,000, while the Appian Way would cost approximately \$300,000 per mile. Needless to say we would still be bogged down in mire if we were dependent upon this type of road construction.

The United States Public Roads Administration has a model of the Appian Way, most famous of the Roman roads, built by H. W. Hendley. This model, four feet wide by eight feet long, on a scale of one-half inch being equal to one foot, was built in accordance with information derived from painstaking research and is believed to be the most complete and varied portrayal of its kind.

Using the information acquired as a result of this research, A. C. Rose graphically describes the method of construction which, somewhat abridged, is as follows:

Excavation of the foundation - Upon solid ground the margins of the roadway were marked by two parallel furrows of a wheel plow, about forty feet apart. Following the location of these furrows, two parallel trenches were excavated to determine the nature of the subsoil and the depth to a solid foundation. The excavators, using a shovel and a combined mattock and pick, and aided by a porter with a basket on his back, removed the earth between the trenches to the level of the roadway.

Consolidation of the foundation - Where unsuitable material was encountered, it was removed and replaced with firm subsoil which was thoroughly tamped with a rammer. If a firm

bed could not be obtained, wooden piles were driven into the foundation. The road-bed was then carefully shaped and levelled to receive the surfacing materials. Even where the excavation revealed a comparatively firm foundation, the sub-soil was always carefully rammed before proceeding further.

Bedding course - Upon the roadbed there was spread a bedding course of sand from four to six inches in thickness, or mortar about one inch thick, made of lime and sand or hassock (soft, calcerous limestone). This bedding course, probably spread to a uniform thickness with a rake, accommodated the irregularities in the undressed lower side of the stones used in the first course of masonry. The lime was slaked in a pit beside the road and later mixed with sand, by means of a long-handled hoe, whereupon it was carried to the road by means of a two-man hod. The water for slaking the lime, generally carried in earthenware jars upon the heads of the bearers, was sometimes conducted from the source of supply in V-shaped wooden troughs.

First course - This course, imbedded in the preceding one, consisted of two layers of flat stones cemented together with well-tempered lime mortar or clay where the former was not available. Varying in thickness from ten inches in good ground to two feet in bad ground, this course was composed of stones ranging in size from small ones sufficiently large to fill a man's hand to large ones which were placed along the sides of the causeway to act as a retaining wall. Since the purpose of this course was to provide a solid foundation,

almost any kind of stone was used, particularly a soft stone, such as was also used in the second and third courses, since the hard stone was reserved for the wearing surface. Ordinary masons worked and placed the stones using such tools as the chisel and mallet, iron wedges, the trowel, the mortar bucket, and the level. Porters carried the heavier stones on their shoulders by means of a sling suspended from poles, and these stones were moved into position by employing a crowbar.

Second course - This course was made of broken stones, smaller than those used in the preceding course. If newly broken stone were used, it was mixed in the proportion of three parts of aggregate to one part of quicklime; whereas if reclaimed aggregate were used, it was mixed in the proportion of five parts of aggregate to two parts of lime. The rammer was used to consolidate, level, and smooth the course which measured nine inches in thickness after compaction.

The first step in laying this course consisted in spreading a layer of mortar over the first course with a rake. The broken stone was then dumped upon the mortar and tamped into it in such a manner that the aggregate was left protruding thereby providing a substantial bond with the next layer. When aggregate for this type of work was hauled for a considerable distance, the two-wheeled cart was used. This vehicle had a basket body, used for carrying heavy loads, and was generally drawn by oxen.

Third course - This course, bonded with the rough surface of the preceding course, was made of concrete consisting of small gravel, coarse sand, and hot lime. Spread in successive layers, each one compacted by a roller, this course was built to a thickness of one foot on the side roads while in the central roadway it was increased to a thickness of one and a half feet. This layer formed the wearing surface of the side roads which were at a lower level than the central roadway.

Wearing surface - This course, which on important roads like the Appian Way, consisted of hard, durable, wear-resisting stone imbedded in the freshly laid concrete of the preceding course, but only within the central roadway. The stone was laid in the form of pentagons, hexagons, or irregular polygons, from one to three feet in diameter and about six inches in thickness, and fitted so closely together that the joints were scarcely discernible. The upper surface was smooth, but the bedded under side was left rough. Sometimes, as is the case with a section of the Fosse Way in Britain, blocks similar to Belgian block, were laid on edge. The less important roads were frequently surfaced with gravel.

Side curbs - The side curbs were two feet wide and projected eighteen inches above the side roads. They were built upon a foundation of large stones resting upon the first course. Mounting blocks were placed along the side curbs at regular intervals.

Dimensions of the Via Appia - The total thickness of the four courses described above varied from three to four and a half feet. The overall width of the Via Appia at the surface was about 36 Roman feet (35 English feet), of which the central roadway constituted $15\frac{1}{2}$ English feet, the two side curbs each 2 feet, and the two side roads $7\frac{3}{4}$ feet.

The Appian Way, worthy as it is of the honors bestowed upon it, must not blind us to the fact that the same attention to construction and maintenance was given to all roads, the only difference being in the materials available, not in the type of construction. Numerous examples have been brought to light in England alone. Gregory describes the road near a Roman bridge at Chollerton in Northumberland as being thirty-five feet nine inches in width between curbstones. The six layers, resting upon a clay subsoil, consisted of six inches of sand, eight to nine inches of rough quarry stones, eight inches of hard gravel partly cemented by lime, eight inches of rough quarry stones, and six inches of yellow sandy earth, making a total thickness of thirty-six inches. The Science Museum, South Kensington, London, has on display a section of a Roman road just recently removed from the western branch of Watling Street near Kenchester in Herfordshire. This section is eighteen inches thick and consists of nine and a half inches of gravel proportioned with lime, four inches of large cobbles laid as flat paving, two inches of sand, and two and a half inches of small cobbles laid as the wearing surface. The roadway itself is twenty-two feet wide and has no curb, only a shallow gutter on each side.

This road bears the unusual distinction of having a flat surface sloping to one side rather than the customary crowned one.

Good roads must have existed in Italy long before the establishment of the Republic for the Etruscans, who first settled on the western coast of Italy north of the Tiber and who arrived in the first half of the 12th century B.C., brought with them from the East the chariot and the arch in building as well as skill in craftsmanship as evidenced by the construction of a stanch bridge across the Tiber. This bridge was used by the early Latins to carry on an exchange of commodities with an Etruscan trading post situated just above the coast marshes. The Tarquins, a race of Etruscan princes, not only ruled Rome, but held sway far to the south into Campania, and some of the famous Roman roads followed at least in part portions of much older roads.

Although road building by the Romans appears to have had its inception with the construction of the Via Appia in 312 B.C., the very earliest extensions of the Roman territory coincided with the beginning of the Roman road system. It is the opinion of Ashby that the first portion of the Via Salaria, leading to Antemnae, Fidenae, and Crustumium, came into existence after the Latin communities on the lower Anio had fallen under the dominion of Rome.

This authority states that

"The correlative of the Via Salaria was the Via Campana along the right bank of the Tiber to the salt marshes from which the Via Salaria took its name, inasmuch as it was the route by which Sabine traders came from the interior to fetch salt. To this period would also belong the Via Ficulensis, which led to Ficulea, afterwards

prolonged to Nomentum, and the Via Collatina, which led to Collatia. Gabii, too, became Roman in fairly early times, though at what period is uncertain, and with its subjugation must have originated the Via Gabina, afterwards prolonged to Praeneste. The Via Latina is, like the Via Appia, obviously a military highway ruled straight on the map, and therefore of artificial origin. Its establishment must be connected with the fighting with the Aequi for the pass of Algidus in the fifth and fourth centuries B.C.

"Three primitive roads to the Alban Hills were probably the original road to Tusculum, which later became the first part of the Via Labicana: the Via Castrimoenensis, which led to Castrimoenium, the modern Marino; and a road which led to Alba Longa, probably more or less along the line of the first twelve miles of the Via Appia. The road to Satricum (Conca) is also of very ancient origin.

"The Via Salaria can hardly have existed as a Roman high-road before the fall of Fidenae (traditionally placed in 428 B.C.), but not long after the capture of this outpost of Veii the chief city itself fell (396 B.C.) and a road, still traceable, was probably made thither. There was also probably a road to Caere in early times, inasmuch as we hear of the flight of the Vestals thither in 389 B.C."

Information regarding roads is available historically and actually. The Antonine Itinerary, compiled about 150 A.D., designates principal towns and stations on many of the main roads. The Jerusalem Itinerary, compiled about 333 A.D. for the use of pilgrims going to Jerusalem from Bordeaux by way of Arles, Milan, Constantinople and Antioch, gives details about particular roads. Four inscribed silver vases, shaped like milestones and dedicated by Spanish visitors at the baths of Vicarello in North Italy, give the stages and distances from Cadiz to Rome. The Peutinger Table, covering almost the whole of the Empire except Britain, of which only a small portion is included, is a 13th century copy made from an ancient road map of the Roman Empire. Actual remains of roads exist everywhere, new discoveries being made even today by such modern methods

as by aeroplane as witness roads located in Syria from the air by the French and British air force. Milestones and other inscribed monuments exist which indicate the routes followed, more than 4000 of the former having been found in many parts of the Empire.

Twenty-nine highways radiated from Rome to the uttermost confines of the Empire. First and foremost in point of importance and high type of construction was the Via Appia regarding which Statius speaks of

"bending my steps where the beaten highway, Appia, queen of far-stretching roads, sweeps along its well-known track."

Queen of the roads it was and still remains, permitting no intruders to share the honor. Initiated in 312 B.C. by the blind censor, Appius Claudius, it extended originally to Capua, a distance of 13 English miles, thereby securing the hold of Rome on Campania. Deviating hardly at all from a straight line, disregarding obstacles such as the Pontine Marshes which were crossed by a high embankment, built to withstand the shock of centuries, it typified as nothing else could the inflexible qualities of Appius Claudius who stood firm when all others about him were shaken by distrust and temerity. Shortly after 290 B.C. the road was prolonged across the Appennines to Beneventum, 32 miles distant. Later still it was extended to Tarentum by way of Venusia going thence to Brundisium and terminating at Hydruntum, an additional 216 miles, making a total of 380 miles. The carriage road, longer by 32 miles, forked at Beneventum going eastward to Barium whence it went southward

to Brundisium and so on to Hydruntum. Passage by boat from Brundisium to Appalonia and Dyrrhachium brought one to the Via Egnatia, begun about 148 B.C., which led across the Balkan Peninsula over the mountains to Thessalonica and Byzantium. Thus we see that the Via Appia held a major position in the road system of Rome since it was the avenue of intercourse to the fabulous wealth and the acquired knowledge of the East.

The Via Flaminia, vying for honors with the Via Appia, was completed about 220 B.C. by C. Flaminius Nepos, although a great portion of it had been laid out about 300 B.C. after subjugation of central Italy. This road ascended the Tiber Valley crossing the river first on the Pons Mulvius and again beyond Mount Soracte. Proceeding on through Umbria it crossed the Appenines to Fanum Fortunae and terminated at Rimini on the Adriatic. From here it was continued by Aemilius Lepidus in 187 B.C. as the Via Aemilia going through Bologna, Modena, Parma, and Piacenza whence after crossing the Po it proceeded on to Milan, 416 miles distant from Rome.

The Via Aurelia, which followed a road already in existence and was so named after the older road was improved about 123 B.C., went first to the sea at Alsium then followed the coast of Etruria to Pisa and Carrara. Extended in 108 B.C. as the Via Aemilia Scaurus it followed the Riviera to Genoa and Nice finally crossing the frontier at the river Var. From here it was continued as the Via Domitia which ran through Aix, Arles and Narbonne to the Pyrenees.

The Via Cassia, like the Via Aurelia, was an improved older

road and traversed Etruscan territory through Chiusi and Fiesole near Florence on to Lucca and the coast south of Luna.

The Via Postumia, built in 148 B.C., started at Genoa and traversed Italy from sea to sea through Dertona, Placentia, Cremona, Verona and so to Aquileia at the head of the Adriatic.

Spain, due to its mineral wealth, seems to have received particular attention with respect to road construction. Carthaginian roads existed there prior to the Roman conquest, but unfortunately very little is known concerning them, and although these were used and improved by the Romans we must, as yet, consider the road system of Spain as of Roman construction.

The Via Domitia which crossed the Pyrenees by a low pass near the coast was improved by Augustus and renamed the Via Augusta. This road led through Tarragona then followed the coast to Valentia where it turned westward over the central plateau into Baetica, going by Cordova and Seville to the great port of Cadiz. According to Sandys:

"Another branch turned west at Ilreda after the crossing of the Pyrenees and reached the Ebro at Saragossa, a meeting place of many roads, the two most important led, one to Bilbilis and Toledo to Merida with a continuation to Bracara Augusta. The plateau of the interior was also crossed from north to south by a road which connected Seville and the other towns on the lower Baetis, and the ports from its mouth to that of the Guadiana, with Emerita, Salamanca and Asturica. Lastly New Carthage on the south-east coast was connected by two roads with the Via Augusta."

Gaul, before Caesar's conquest, had quite an extensive road system, but to what extent the Roman highways followed these roads it is difficult to determine. It is evident that the pre-Roman roads of Gaul were not only well laid out, but were also well maintained, because Caesar was able to move his troops

with great rapidity during his Gallic campaigns, and Hannibal's army advanced as much as 24 miles a day.

The oldest road into Gaul was over the Via Aurelia and the Via Domitia by Nimes to Narbo where one branch turned to Tolosa on the upper Garonne whence it went on to Bordeaux. The most used road led from Milan through Turin on the upper Po and across the Alps by the pass of Mount Genevre and so to Lyons. Another route led by way of Aosta through the Little Saint Bernard Pass, down the Isere to Grenoble above which the road diverged from the Isere to Geneva and so to Vienne and Lyons. The most difficult of the Alpine roads, however, was over the Great Saint Bernard Pass into the upper Rhone above the Lake of Geneva and thence through Swiss valleys to the Rhine. Another road led north from Verona to Trent, over the Brenner Pass and so to the Danube Valley.

The focal point of all the roads in Gaul was Lyons, so chosen by Agrippa. From this city, according to Sandys,

"one road ran west through Aquitania to Saintes at the mouth of the Garonne; another descended the valley of the Loire to Bourges and Tours, with branches to Orleans and Poitiers; another followed the Saone to Chalons where it forked; the western branch proceeding by Augustodunum to the ports of Lillebonne at the mouth of the Seine and Boulogne, from which passengers embarked for Britain, while the eastern branch followed the river Doubs to the Rhine. The road from Chalons to Boulogne skirted the basin of the Seine and its tributaries on the east, passing by Troyes, Reims, Soissons and Amiens. At Reims a branch turned east, reaching the Moselle at Trier and ultimately joining the main Rhine Valley road a little below Mainz. Thence it followed the river frontier by Cologne to Leyden near its mouth."

Britain like Gaul had roads long before the Roman conquest and evidence of these ancient roads have been found in southern

England. The oldest ones traversed the crest of the hills and are known as Ridgeways, these were followed by the Harrow Ways which were built along the lower slopes high enough above the valleys for easy drainage and still avoid excessive gradients. Remains of the Ridgeways are to be seen in the Icknield Way and the Peddars Way, and of the Harrow Ways in the Pilgrim's Way which runs from Winchester to the shrine of Thomas Beckett in Canterbury. The Harrow Ways in all probability served as avenues of transport for tin from the west of England to the channel ports for passage to the continent, because Diodorus informs us that Cornish tin was transported across England in wagons. Some authorities are of the opinion that the Romans did here as they did everywhere else - followed existing roads - and that such outstanding examples as the Foss Way, Watling Street and Ermine Street are all pre-Roman. The early existence of roads is also proven in the names themselves, Icknield Way being originally Icen-Hilde-Weg (the war way of the Iceni), and Watling Street being so named after the wattles that were used in the original construction.

Boats crossing the Channel from Boulogne landed at the ports of Richborough, Dover and Rye and roads from these ports converged on Canterbury which was connected with London by Watling Street, most famous of the Roman roads in Britain. London very early became the center of Roman commercial interests and from here roads spread out in every direction so that all of England, Wales and the southern part of Scotland was readily accessible.

Watling Street, the main road from London to the northwest,

passed through St. Albans, Dunstable, Towcester, High Cross and Wall (12 miles north of Birmingham) beyond which it turned westward to Wroxeter on the Severn. Continuing northward from where it branched westward to Wroxeter, this road passed through Chester, Manchester, Overtown and on to Burd Oswald, the central camp on the Roman Wall, with extensions into southern Scotland.

Ermine Street, the great north road from London, passed through Godmanchester (west of Cambridge) and Lincoln to York from which a number of roads radiated in various directions.

Foss Way connected Axminster and Lincoln by way of Ilchester, Bath, Cirencester, High Cross on Watling Street, and Leicester.

Riknield Street branched off the Foss Way north of Cirencester, crossed Watling Street, passed through Derby, and proceeded on towards York.

Stane Street, to the south of London, ran to Chichester, while to the north, it branched eastwards from Ermine Street at Braughing, going thence to Colchester, the chief center of Roman influence before the conquest. From here Peddars Way led northward to Brancaster.

The great western road from London went by Silchester, Badbury Rings, Dorchester and Axminster to Exeter.

All along these main routes, side roads or cross roads led off to various destinations so that Britain was well served with good roads, portions of which are still in existence.

Throughout the entire East, in Egypt, in Africa, in fact everywhere that the Roman legions penetrated, the thought fore-

most in the minds of the Romans was to establish excellent roads. Usually it was only necessary to take over and improve roads which already were many centuries old, roads on which Time had written the history of man throughout his long struggle upwards, roads which had witnessed the successive rise and fall of mighty empires, some of them long ago relegated to the limbo of the mythical, soon to be the fate of Rome itself.

Rome was never a hypocrite or a bigot in her attitude towards the conquered countries. Philanthropy and cultural interest played no part in developing her provinces, she was solely interested in making them a profitable source of income. Race and creed was of no consequence. That which was useful was accepted and allotted its rightful place in the economic system of the empire. No clearer example of this can be cited than that the voluminous trade which flowed back and forth was largely in the hands of easterners even in Italy itself, but the purse strings were held by Rome and this because the vital importance of excellent communications was ever in the forefront to create homogeneity in government. That the whole and not the individual parts determine economic stability was fully realized by Cicero when he stated that

"The credit of the Roman money-market is intimately bound up with the prosperity of Asia; a disaster cannot occur there without shaking our credit to its foundations."

The modern engineer can justly be proud of his ancestry and not the least of these in point of technique and ability to overcome natural obstacles, ever present to contest the

ingenuity of man, was the Roman highway engineer. When confronted by seemingly insurmountable obstacles, rather than try to avoid them, the Roman engineers seemed to glory in the opportunity of grappling with them. Very little regard was displayed towards topographical difficulties. Strabo describes the roads as being built by cutting through hills and filling up valleys, and according to Plutarch,

"they were driven straight across country, regardless of obstacles, paved with smooth stone, and strengthened with mounds of rammed earth. The hollows were filled, the torrents and ravines which cut the line of the road spanned by bridges, so that the height on each side was the same, and the whole work had a regular and elegant appearance."

Marshes were crossed by high embankments as was the case of the Appian Way in traversing the Pontine Marshes, and the causeways built by Germanicus over the marshes of Westphalia. Many of these embankments were built with material borrowed from excavations alongside the road and spread in successive layers which were compacted by the use of stone rollers and rammers. Considerable length, height, and width was on occasions attained by these embankments. On the Appian Way alone we find one embankment across the Pontine Marshes, built during its reconstruction by Trajan, to be seventeen and a half miles long and thirty-nine feet wide; another one at Arricia, mentioned by Leger as being built with stone retaining walls, is seven hundred and forty-five feet long, forty-one feet wide and maintains an average height throughout of forty-three feet.

The preeminent consideration given to a firm foundation is illustrated by the fact that in marshy terrain stability was

assured by driving piles to secure a solid footing. With reference to the construction of causeways over the marshes of West-halia, we learn from Tacitus that

"Caecina was sent forward to explore the woods; where the waters were out, to throw up bridges; and by heaping loads of earth on the swampy soil, to secure a solid footing,-"

and again that

"he (Caecina) had directions to pass the 'long bridges' with all possible expedition. The place so called is a narrow causeway, constructed formerly by Lucius (grandfather of Nero). It stretches a great length of way between two prodigious marshes. The country round is one vast fen, in some parts covered with a deep and slimy mud, in others with a tenacious heavy clay, intersected frequently by rapid torrents. The bridges, ruined by time, were to be repaired; and the enemy at the same time was to be repulsed."

Another example of this type of road construction has been found in Britain, built across the mud of the Medway near Rochester. Payne wrote in 1898 in *Archaeologia Cantiana* that

"When the Romans made the great way from the Kentish coast to the north of England, a wooden bridge, built upon piles, was thrown across the Medway. On reaching the Strood side of the river the engineers were confronted with a marsh of about 355 yards in width. This difficulty they boldly overcame by constructing upon the alluvial deposit a magnificent causeway.

"A section of the buried work showed the following:-
 (1) Layers of post-Roman roads for a depth of 2 feet 8 inches; (2) paved surface of causeway, 6 inches to 8 inches; (3) small pebble gravel, mixed with black earth, rammed, 9 inches; (4) flints, broken fine, 7 inches; (5) rammed chalk, 5 inches; (6) flints (white, and rather large), rough pieces of Kentish rag, fragments of Roman tile, 3 feet 6 inches; (7) marsh mud, containing numerous oak piles about 4 feet in length, with pieces of wood laid at intervals across them, or perhaps they were originally made fast by nails. The width of the causeway was about 14 feet, while the distance apart of the wheels of the waggons has been estimated, from the grooved wheel-track, at $4\frac{1}{2}$ feet."

Hills and mountains were traversed by means of sidehill

excavations, open cuts, and frequently by tunnels. Since all excavation was performed by hand, cuts through solid rock were often by tunnels rather than by open cut thereby materially decreasing the amount of labor. One cut cited by Leger is through a marble cliff on the Appian Way near Terracine and is one hundred and seventeen feet high and ninety-eight feet long, while a tunnel on the same road, according to Gregory, was half a mile long. The Flaminian Way crossed the Appenines by means of a tunnel constructed by Vespasian and was about nine hundred and eighty-four feet long.

Rivers were crossed mainly by excellent bridges of stone or timber or a combination of the two, but occasionally passage was by means of ferries or pontoon bridges. Stone bridges were built in a series of arches and the first large bridge of this type of which we have any definite date was the one built at Rome in 179 B.C. A stone-arch bridge across the river Nar, 60 miles from Rome, had a central arch with a span of 150 feet and a rise of 100 feet and was pronounced by Addison as the state-liest ruin in Italy. The famous Pont du Gard at Nismes was 880 feet long, serving mainly as an aqueduct, but also as a bridge. Another famous stone bridge was that over the Tagus at Alcantra, consisting of six arches, while still another one of eight arches was built over the Rio Tinto at Niebla in southern Spain. The timber bridge was probably most frequently employed because of the ease of construction and the availability of material. This type was apparantly used when a long light bridge was constructed on weak foundations as the one over the Thames in

London. The combination of masonry substructure, in the form of stone piers, and timber superstructure was also used to a great extent and over considerable distances as was true of the great bridge, consisting of twenty spans, built by Trajan over the Danube. Ruins of these bridges, excepting those of timber, exist in practically all of the countries embraced by the Roman Empire and attest to the ability of the engineers both from the standpoint of design and construction.

The legendary straightness of Roman roads as mentioned by Plutarch is somewhat exaggerated, yet this should not detract from the splendid display of road location for, regardless of deviations resulting from a desire to avoid some obstacles, directness of the route as a whole was never lost sight of. Long tangents were extensively employed, more so probably than at the present day. On Watling Street from Dover to Wroxeter there are eleven tangents, some of them twenty-five miles long while in level country long straight stretches exist as over the sixty mile approach of the Appian Way to the sea and in the plains of the Po. Curvature and switch-backs were utilized when it was advisable to avoid unnecessarily deep cuts and to attain elevation, however, scant heed seems to have been given to easy gradients since excessive grades up to fifteen and twenty per cent were permitted. Horace evidently did not take kindly to these steep grades for he advises that

"they were less fatiguing to those who traveled slowly."
Curves of large radii were necessary at times since passage had to be provided for wagons drawn by as many as five teams in

tandem. At other times dangerously sharp curves, with a radius of from twenty-three to twenty-six feet, were employed to avoid difficult hillside cuts as was the case with one described by Leger, at the Saint Clair bridge near Annecy, built on a fifteen per cent gradient through a cut eleven feet in width. Long tangents, however, rather than curves, seems to have been the forte of the Roman engineers and it is for these next to the permanency of construction that they are lauded.

The magnificent and extensive system of roads, built and consistently maintained by Rome, rightfully gave her one indisputable claim to glory. It is commonly said that all roads led to Rome, rather would it seem more appropriate to say that all roads led from Rome, for nothing so forcibly visualized her power, her glory, and her grandeur as did these lifelines, reaching outwards in all directions to encompass, protect and foster the interchange of trade and ideas. The heart was Rome, but the arteries were the roads carrying the life blood of an empire to the remotest member of the body politic. The world did not come to Rome, Rome went to the world, and this by the ever expanding network of roads, built not to serve as avenues of conquest, but after victory had been accomplished. It is not because of the wealth that flowed into her coffers that Rome lives in history, but because of the enforcement of law, the encouragement of commerce, the interchange of Knowledge, which flowed away from Rome. Over these roads spread a civilization of such breadth and depth that, although politically Rome is dead, intellectually she still lives and continues to influence us through her law, her language, and her literature.

EUROPEAN ROADS

"Roads that are rotten full rightly repair,
Or bridges, when broken, build up anew."

Vision of Piers the Plowman

EUROPEAN ROADS

The fall of Rome and with it the collapse of the Western Empire resulted in complete disintegration of unified government. Commerce which had flowed unhampered in a steady stream over the magnificent highways built by Roman engineers dwindled for a time to mere rivulets of barter between neighboring communities. Thriving centers of trade suffering from rickets of commercial malnutrition either dwindled away completely or withdrew their emaciated frames behind the cloak of localized annui. According to Engels:

"Universal impoverishment, retrogression in the matter of communication, of manufactures, of art, decline of population, decay of towns, the degeneration of agriculture into more primitive forms - such was the final result of the Roman world-empire."

Rome having learned how to govern, became satiated with power, and promptly forgot how to govern. Surfeited by the enervating luxuries derived from tax-burdened provinces, Rome fell because she no longer had the strength to stand.

Contrary to the near collapse of commerce in Europe, that of Asia and northern Africa continued to flourish for many centuries under the Arabs. An elaborate system of roads was laid out and maintained under the Baghdad Khalifate, and a part of the public revenue was allocated for the purpose of constructing and maintaining roads. Burton states that,

"a network of waterways, irrigation canals, a noble system of highways provided with viaducts, bridges, and caravanserais, and a postal system of mounted couriers enabled it to collect as in a reservoir the

wealth of the outer world."

Unfortunately too little attention has been paid to the Islamic civilization which kept the torch of learning alight while all Europe groped in darkness.

The rise of petty kingdoms in Europe whose lust for personal aggrandizement and the consequent lack of unified government soon brought about disintegration of the splendid Roman roads which crisscrossed the land in every direction. Organized bands of robbers, oftentimes under the direction of the princes themselves, used the roads as a source of income, robbing and killing those who dared to venture forth. That highway robbery was so commonplace that it made every man suspect is brought out in an order, probably the oldest English ordinance having reference to roads, issued by King Alfred about 900 A.D. which commands that

"If a far coming man or a stranger journey through a wood out of the highway, and neither shout nor blow his horn, he is to be held for a thief and either slain or redeemed."

Robinson states that

"One of the outstanding difficulties which stood in the way of creating large and powerful states during the Middle Ages was that a king found it very hard to get rapidly from one part of his realms to another in order to put down rebellions, for the remarkable roads which the Romans had carefully constructed had fallen into disrepair.

"To have good roads one must constantly work on them, and as there was no longer a body of engineers employed by the government to keep up the roads and repair bridges, they often became impassable."

The belief, however, that road construction and maintenance ceased entirely during the Middle Ages is unfounded for attempts, although sporadic, were continuously being made to

improve communications. Charlemagne constructed good roads and bridges and his concern over their maintenance is brought out in his capitularies. The main difficulty was the lack of continuity in either construction or maintenance for what one section did in the way of improvements was not continued by the adjoining one. Boissonnade tells us that

"The Carolingians tried to restore and keep up the Roman roads, fallen into disrepair, by means of forced labor. Both they and the Visigothic kings regulated the width of roads and put them under the protection of public law. But these regulations were not observed for long, and roads and tracks were left alone. No active movement was possible on account of the degradation of the roads and the persistent menace of brigandage."

Gradually, as readjustment to the new economic order became more firmly established, we note a perceptible forward movement in widening commercial intercourse. Central governments gaining in strength, dislocation of organized brigandage, growth of towns and marked stability of their government, powerful merchant companies, and the Church all realized the importance of roads and all contributed their share towards improvement. It is to the credit of the Church that it never lost sight of the importance of intercommunication, and the first associations for the repair of roads and bridges were established under its aegis.

This was particularly true with respect to bridges, interest in which resulted in the organization of the Bridge Brothers composed of both the laity and the clergy. Credit for this movement is given to Vimarís, a young French priest, who, at the close of the 12th century believed he received divine instructions to construct a bridge over the Rhone at Avignon

which was then a popular meeting place for pilgrims on their way to Rome. The building of this bridge (1177-1189) created such interest throughout Europe that the order of Bridge Brothers was established which resulted in the construction of the Pont Saint-Esprit, still in use, and many others. Boissonnade tells us that many other bridges such as those

"of Lyons, Paris, Tours, London, Stratford, Florence, and Valencia in Spain belong to this period."

According to Thompson, the care of roads was looked upon as a pious and charitable duty, and to endow a bridge or stretch of highway, or to labor upon the same, was efficacious in absolving from sin, just as the giving of alms or the making of a pilgrimage. Frequently, when a local situation became desperate, indulgences were granted by neighboring bishops to those who would give either the means or labor for repairing of the highways. The crusades were also to a large extent instrumental in reviving trade and arousing interest in better means of communication for it created intercourse on a large scale and united the people in a common cause.

All of these efforts, although disunited, were conducive to an increased growth of trade and travel. Boissonnade notes that

"The great continental highways between Italy, France, and Central Europe, by Geneva, Mont Cenis, the Saint-Bernard, the Saint-Gothard, the Splugen, and the Brenner Passes were covered with caravans of merchants, as were those of the Rhone, Rhine, Meuse, Scheldt, Seine, Loire, and Garonne Valleys leading to the West of Europe, or the passes of the Western Pyrenees by Roncevaux and of the Eastern Pyrenees by Cerdagne, which led to Spain. The first more or less regular services of passenger carriages, couriers, and goods wagons were organized by the care of ecclesiastical or urban trading corporations, or even of states. A postal service appeared in Italy in the 12th century, and in Germany towards

1237. The great road which unites Northern Germany to the East by way of Bohemia and Hungary was reopened. Commercial centres sprang up in the 12th and 13th centuries - Prague, Budapest, Breslau, Danzig, Cracow, Riga, Pololsk, Novgorod the Great."

As royal power began to increase we perceive governmental attempts to improve the roads, but there was no unity of thought or action. The desire to do something was there, but the initiative or ability to carry it into action was lacking. Everyone experienced the difficulty of trying to travel over these roads, everyone complained most strenuously, statutes were passed, orders were issued, but still the condition of the roads remained deplorable. It was as if a child had learned the alphabet thoroughly but had never been taught to spell. Bridge states that

"It was a maxim of the medieval jurist that there were five sorts of road: first, the foot-path, with a width of four feet; next the bridal-path, with a width of eight feet; then the road of sixteen feet, on which vehicles could pass one another; after that, the highway of thirty-two feet; and, finally, the Roman road with a width of sixty-four feet. For the existence of any such precise and grandiose classification there was small justification in actual facts. If the Roman roads still existed it was because their makers had built them to endure, and not because the Middle Ages had done anything to promote their endurance. In the neighborhood of big cities the roads were sometimes metalled for short distances, and measures were taken intermittently to facilitate the passage of dangerous spots; but in the open country the road looked after itself."

Laws passed in various countries indicate that the importance of roads and bridges was fully appreciated, although the power to enforce the laws was generally lacking. Various communes in Italy decreed that new roads should be laid out and maintained and that existing roads and bridges should be repaired. Many of

the German states had laws stipulating the width of main and secondary roads, regulations as to their maintenance, and privileges with respect to using them. Henry I of England, in 1135, ordered that all highways should be broad enough for two wagons to pass each other. Philip II of France, about 1180, ordered that the two main streets of Paris, one running north and south and the other east and west, should be paved. The Magna Carta (1215) specifies that

"Neither a town nor a man shall be forced to make bridges over the rivers, with the exception of those who, from of old and of right ought to do it."

The Statute of Winchester (1285) directed

"that highways leading from one market town to another shall be enlarged where as bushes, woods, or dykes be, so that there be neither dyke nor bush whereby a man may lurk to do hurt within two hundred feet of the one side and two hundred feet of the other side of the way."

Emperor Sigismund levied a tax for the maintenance of roads, believed to be the first of its kind.

Subsequent acts in various countries indicate an increased interest in roads, but withal progress in general was rather haphazard due to lack of centralized authority. That roads and bridges continued to function at all was largely due to good will rather than to governmental action since unified control had not yet been established. An outstanding example of this condition is that of the bridge over the Medway at Rochester on the London-Dover Road. Richard II (1391-1397) replaced the old wooden structure with a stone bridge of nine arches and according to Webb

"the Archbishop of Canterbury was responsible for the fifth and ninth arches and piers, the Bishop of Rochester

for the first, the King for the fourth, and certain manors for the second, third, sixth, seventh and eighth."

One of the most surprising discoveries of comparatively recent years is that the Vikings, usually visualized as the scourge of Europe, had in reality a much higher standard of civilization than that of many of their contemporaries.

Thompson believes that

"It is hardly possible to overestimate the influence of the Norse upon medieval history. They lifted the whole north of Europe above the horizon of the unknown into the known."

Mawer's opinion is that

"Of the great movements which have contributed to the making of modern Europe, the Viking movement, though certainly among the greatest, is probably the least familiar to the majority of historical students, professional and amateur alike. The Vikings can be shown to be pioneers in geographical discovery, chief among the founders of modern commerce, the possessors of a literature of unsurpassed value, men endowed with the highest technical and artistic skill."

We are prone to think of the Vikings purely in the light of sea rovers and maritime merchants using their fjords as a base of operations, but we now know that land trade and transportation was also a subject of considerable interest to them and the condition of their roads was far better than of those in many parts of Europe. That the Vikings fully realized the importance of roads and were quite adept in building excellent roads and bridges is brought out by Williams who states that

"The Viking Age in Scandinavia was characterized by a great amount of activity, not only externally, - displayed by commercial journeys and warring expeditions to foreign lands, - but also within the borders of the different countries of the Scandinavian North. The unusual mobility of the population made the question of transportation facilities one of importance.

"Considerable attention was, consequently, paid to

internal improvements along this line; and, in view of the earliness of the period, a goodly amount of progress was evident in response to the various needs. The law in some instances required that wagon-roads of a certain width be constructed through every farm, and that they be so built as to be equally good in dry and in wet weather.

"The word 'bridge' among the ancient Northmen had two meanings, and included bridges in the present day sense, and also causeways. Perhaps it was most frequently employed in the latter sense, for during the period considered the areas of undrained land were much greater than at present, and in many cases the only way in which transportation across them could be made possible was by means of high, artificial roadways made of layers of stone and gravel, edged by large heavy stones held in place by long ones standing on end, or by a support of wood. But bridges in the present meaning of the term were also built. They were of wood, though at times upon stone foundations, and some of them spanned deep, wide streams. No charge appears to have been made for their use, but the law protected the owners against damage done them. "The coming of Christianity gave an impetus throughout the North to road-making and the building of causeways, bridges, and ferries; for wayfarers, like the sick and the poor, were regarded as fit objects for pity and assistance. Hence, pious men and women constructed free public aids to traveling for the good of their own souls, or for the benefit of the spirits of departed relatives or friends. These were known as 'soul-roads', 'soul-ferries', and 'soul-bridges', and in Sweden, at least, they were marked by monumental stones bearing explanatory inscriptions. The famous Sigurd Tafnesbane runestone, which dates from the first half of the 11th century, is such a memorial stone, and it was used to mark a bona fide bridge."

As a nation, France showed greater perception than any other in Europe for the need of serviceable roads, and very early began constructing and maintaining a national system of highways, a practice which has been carried forward unabated to the present day. This was largely due to centralization of power in the hands of the king and a strong national unity among the people. According to Bridge,

"In 1508 the general supervision of highways, ports and harbours was entrusted to the four Royal Treasurers, the proceeds of Royal tolls being allocated to purposes of

maintenance; and where a private toll-owner ignored his liability, the Treasurers were empowered to execute necessary repairs at the defaulter's expense. Invested with these powers, the Treasurers remained the chief highway authority until relieved of their duties upon the creation of Intendents."

Strengthening and consolidation of royal power brought about increased co-ordination, so that, according to the same author, the result

"if not brilliant, was yet appreciable, for by the middle of the 16th century, as we learn from a contemporary road-book based upon reports of messengers, merchants and pilgrims, France possessed no less than 15,000 miles of practicable roads; three important routes connected the north with the south; paved ways radiated from Paris and some other big towns; and districts were even to be found in which a regular service by carrier had been established."

Prior to this we find that as early as about 1300, Philip IV tried to establish a systematic network of roads and although the plan failed to materialize, it indicates that France at this early date was already formulating plans for the construction of roads on a national basis.

Road building in France showed marked improvement under Henry IV with the result that from 1600

"it completely mastered this science and its materialization in Europe for two centuries."

Sully, minister under Henry IV, held the office of 'Chief Road Surveyor of France' and under his administration roads improved rapidly. Bridges were repaired and rebuilt, and roads were repaired, widened and straightened. A million livres a year were allocated from the Royal Treasury for road alone. War and religion so occupied the attention of Richelieu and Mazarin that progress was retarded, but Colbert, minister under Louis

XIV from 1660-1669, had about 15,000 miles of stone roads constructed. Interruptions again occurred due to the many wars in Europe so that the next step forward was one of utmost importance; the establishment of the State Department of Roads and Bridges by Order of Council in 1716, followed by the establishment of the Corps of Engineers of Bridges and Roads between 1750 and 1754. About 1775 a new type of construction and a systematic method of maintenance was proposed by the famous French engineer, Tresaguet, father of modern road construction. The Tresaguet system became the standard in France and by 1788, 12,000 miles of roads had been built and the same amount of mileage had been laid out and partly built, but progress was again retarded, this time by the Revolution.

Although at this period the art of road building took on added impetus, there stalked through the picture, the spectre of forced labor. Men were being inoculated with the dignity of freedom and a resistance was being built up to the enervating disease of serfdom. The corvee, which was in reality legalized serfdom, not only impoverished the individual by depriving him of his meagre opportunity to eke out an existence, but it weakened the economic structure of the entire nation by drastically curtailing agriculture. Under the corvee the peasantry were forced to labor on the roads without pay for long periods, sometimes at great distances from their homes, even during planting and harvest time. So great was the hardship inflicted upon the people that rioting and insurrection broke out and the condition of the people became almost unbearable.

Although the use of forced labor on roads and all other forms of public work had been practiced from ancient times, there appears to have been no attempt, on a national scale, to abolish it until Turgot in France sought to relieve it in 1774 by replacing it with a tax on land. A few isolated attempts had previously been made to do away with forced labor on roads for we find that in the American Colonies, the government established in 1665 by the Duke of York provided that wages should be paid and "that no ordinary laborer shall be compelled to work from home above one week together." In Ireland the corvee was abolished by statute in 1762, however, it lasted in England and Wales until 1835 when it was abolished by the General Highway Act, and in the United States it was continued in many states until the advent of the automobile. In France the strenuous opposition of the privileged class, greatly assisted by Marie Antoinette, brought about the dismissal of Turgot and the corvee was reinstated and was not finally abolished until 1787, when the nation was on the brink of revolution.

Regarding the corvee, Turgot expressed himself thus:

"The weight of the burden only falls, and can only fall on the poorest class of our subjects, those whose only property is their manual labour and their industry, on cultivators and farmers. Landowners and almost all the privileged classes are either exempt from it or contribute to it in an infinitesimal degree; and yet it is to landowners that roads are beneficial, by the value which multiplied communications give to the produce of their lands. - - - It is therefore the class of landowners which derives the profit from the making of the roads; and they should advance the money, since they derive the interest from it. How can it be fair to oblige those people to contribute who have nothing that they can call their own; to make them give their

time and their labour unremunerated, to take from them the only resource they have against misery and hunger, compelling them to work for the benefit of citizens richer than themselves."

Obviously such a revolutionary step forward could not be long-lived under the social and economic barriers then existent.

Leon Say remarks that

"The decree on the corvee has been most violently attacked, for the simple reason that it contained so formal and so direct an attack against privileged classes, and was a first step in the direction of equality of all proprietors with reference to taxes."

Road building in France had its revival under Napoleon who, although incessantly engaged in warfare, yet found time and the means to construct a magnificent system of highways and many other public works of which he was justly proud. Of the many roads built by Napoleon, the most famous and the most spectacular, ranking even today as one of the great engineering feats in history, was the Simplon Road over the Alps. Extending from Brieg, Switzerland to Domo d'Ossola, Italy, a distance of 48 miles, it took five years (1801-1805) to build, and was constructed by Napoleon's engineer, Nicolas Ceard, at the cost of 18 million francs. Regarding this road, Kirby and Laurson state that

"The construction was carried on principally by two brigades of French engineers; at one time 30,000 men were employed. There are some 611 stone bridges and 10 galleries or tunnels on the route."

According to Gregory:

"the road is nine yards wide; the gradient is 1 in 29, and the summit level is at 6627 feet. The most difficult part of the route was the passage of the stupendous ravine of the Gondo, one of the wildest and grandest gorges in the Alps, which is traversed in part by a tunnel 731 feet long."

Another remarkable road, built during this period, was that over the Mont Cenis Pass, started in 1803 and largely completed by 1810, estimated to have cost approximately \$1,500,000.

The importance of roads to national life and his pride in their construction is brought out most forcibly by Napoleon himself. Angered by a statement which he read in an English newspaper, while in exile, that he had hidden away vast treasures, Napoleon dictated the following:

"Would you like to know about Napoleon's treasures? Yes, they are vast, but they are not hidden away. - - - the high roads from Antwerp to Amsterdam, from Mainz to Metz, and from Bordeaux to Bayonne; the passes over the Simplon, Mont Cenis, La Corniche, and Mont Genevre, which open up the Alps in four directions, and excel all the constructions of the Romans. Then there are the roads from the Pyrenees to the Alps, from Parma to Spezia, and from Savona into Piedmont; the bridges across the Seine, and the bridges of Tours and of Lyons; - - - These are the treasures of Napoleon, which represent an expenditure of milliards, and will outlast the centuries! These are the monuments which defy calumny - - - Moreover, history will record that they were all erected while long wars were being waged, and without loans being raised to pay for them!"

It is rather difficult to write coherently about the history of roads in most of the countries of Europe due to the inability to secure sufficient information. The Germanic countries were, of course, seriously handicapped by internal dissensions, consequently we find that the roads which were built were those promoted by various princes at their own behest in an attempt to stimulate economic development, yet it seems strange that progress along this line was so backward. Forbes states that

"Several plans were, certainly, drawn up at the time of Frederick II of Prussia. Luder did very good work and, moreover, the manuals on roadmaking which appeared in the German language were very valuable. Yet the matter got no further than planning. It was not until

1720 in Southern Germany and 1787 in Prussia that plans on a large scale were carried out, the latter country having no more than 500 miles of State roads in 1816."

Austria under Leopold I and Charles IV made excellent hard core roads and Joseph II had the excellent foresight to follow Turgot's example and abolish the corvee in actuality before either France or England. We also find, according to Renard and Weulersse, that

"A service of imperial posts was arranged to facilitate transport, and the famous Via Josephine, crossing the mountains of Carniola from Karlstadt to Zeugg, opened a new access to the Adriatic."

We find also that, as early as the Renaissance, the Hauenstein Road was built in Switzerland between Soleure and Basle. These same authors state that excellent roads existed in the Netherlands in the middle of the 16th century, and that Philip V of Spain constructed a network of highways radiating from Madrid.

Russia, it appears, was far behind other countries, due largely to a very small amount of internal trade, and the roads which existed in the 16th century seem to have been hardly worthy of the name. The first attempt to build substantial roads on a national scale was under Peter the Great. A present-day author, Krynine, informs us that

"In the first part of the 18th century, Peter the Great and his successors constructed the 'Prospective Road' between the old capital, Moscow, and the new one, St. Petersburg. This road, more than 700 kilometers long, was under construction during 26 years and was finished in 1746 - - - During the period 1817 to 1834 this road was macadamized and partly relocated - - - The first macadam highway was constructed in Russia under Paul I (1797-the highway Tsarkoye Syelo - Gatchina)."

One unusual type of road, consisting of a wood-block pavement, seems to have originated in Russia, being invented by

M. Gourief, a member of the Russian Academy of Sciences.

According to Kirby and Laurson,

"The first wooden-block pavements were laid upon his proposal - the Great Sea Street and Million Street in St. Petersburg. In 1836 M. Gourief published a book in which he proposed to lay wooden-block pavements on all the principal Russian highways and to establish a system of transportation by trains, each consisting of a steam locomotive and three or four wagons, without rails."

Regarding this type of road, Leitch Ritchie, in 1836, wrote that

"The wooden pavement, I believe, is peculiar to St. Petersburg, and merits a description. It consists of small hexagons sawed from a piece of resinous wood, and laid into a bed formed of crushed stones and sand. These are fastened laterally into each other with wooden pegs, and when the whole forms a plain surface, the interstices are filled with fine sand, and then boiling pitch is poured over all. This pitch from the porous nature of the wood is speedily absorbed, and on a quantity of sand being strewed above it, the operation is complete, and a pavement constructed which is found to be extremely durable, and which seems to suffer much less injury from the frost than the stone causeway. The honour of the invention is due to M. Gourief; and I have no doubt he will ultimately see it adopted in most of the great towns toward the north. It is the custom of the peasants to cut down the trees at some distance from the root, and thus a great deal of wood will be turned to a useful purpose which would otherwise only encumber the ground. Every peasant, besides, by means of his axe alone, is able to construct such a pavement, and in Russia hands are both plenty and cheap."

Road construction in England, based on sound engineering principles, seems to have lagged considerably behind that in France and other countries up to the advent of Telford and MacAdam. True there were any number of statutes enacted for the purpose of bettering the condition of roads, but these were usually mere legal formality since very little improvement resulted. If one is to believe the vociferous accounts of

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numerous travelers, the roads were indeed deplorable. A road in the sense of a made way was, in the early periods, considered not so much the line of the road proper as it was the right of passage through the country. This interpretation is cited by Webb who states that

"In one of the oldest law-books it is definitely laid down that "the King has nothing but the passage for himself and his people." What existed, in fact, was not a road, but what we might almost term an easement - a right of way, enjoyed by the public at large from village to village, along a certain customary course, which, if much frequented, became a beaten track. Judges held that "the good passage" and not only "the beaten track" constituted the highway. Passage off the road was frequent for in 1610 from the very first book about roads that is extant, we read of "great hurt and spoil of fences and grounds, with riding and going over the corn and such like, by shifting and seeking the best way diversely."

The numerous acts created from the time of Henry VIII onward indicate that attempts were made from time to time to improve the condition of roads, but with indifferent results, due largely to laxity of enforcement and total absence of engineering supervision. In 1523, Henry VIII granted authority for the abandonment of old roads and the making of new ones in Kent, this by the consent of two Justices and a Jury of twelve men. This authority provided that

"two justices of the peace and twelve men of wisdom and discretion shall choose fresh routes where the old ones are worn out."

The occasion for this act was that

"common ways in the said county of Kent be so steep and noyous by wearing, and course of water, and other occasions, that people cannot have their carriages or passages by horses upon or by the same, but to their great pains, peril, and jeopardy."

This same power was given to the County of Sussex in 1534.

Three other statutes between 1532 and 1540 authorized the paving of highways out of London, which were

"very noyous and foul, and in many places - - - very jeopardous"

to passengers,

"as well on horseback as on foot, in winter and summer, by night and by day."

Six road acts were passed during the reign of Queen Mary and nineteen during that of Queen Elizabeth, and we find that the Privy Council, under Charles I, had the roads measured and posts put up at the fifth mile.

Regarding one of the most important acts during this period, Webb states that the

"Statute of Parliament of 1555, known as 2 and 3 Philip and Mary provided for maintenance of all existing public highways by the Parish as a whole and on every inhabitant thereof. The first duty of the Parish was to provide, from among its inhabitants, one or more persons to serve gratuitously as Surveyor of Highways for the ensuing year. All manual labour, tools, and horses and carts needed for repairing roads had to be furnished free by the inhabitants. "Every person, for every plough-land in tillage or pasture" that he occupied in the Parish - subsequently defined as a holding of £50 annual value - "also every person keeping a draught(of horses) or plow in the Parish" had to provide and send "one wain or cart furnished after the custom of the country, with oxen, horses, or other cattle, and all other necessities meet to carry things convenient for that purpose, and also two able men with same." Finally, "every other householder, cottager, and labourer, able to labour, and being no hired servant by the year", was either to go himself to work or to send "one sufficient labourer in his stead." The Surveyors of Highways, under this act, had to make at least three inspection trips during the year in order to "view all the roads, highways, water-courses, bridges and pavements within his precinct, and make presentment upon oath in what condition he finds the same to the next Justice."

Some of the most decisive steps for betterment of roads were taken by the Government of the Commonwealth which instituted a

compulsory tax for maintenance, and in 1657 Parliament had under advisement "A Bill for Repairing of the Highways and Improving the Public Roads", also a "Surveyor General of the Highways" with authority throughout the whole kingdom had been appointed by Cromwell. All of this work came to naught, however, for with the Restoration, all of the legislation of the Commonwealth became invalid.

Constant demands for road improvements resulted in Parliament authorizing, in 1663, the construction of turnpikes which ostensibly should have been of considerable benefit since the tolls were intended to be used primarily for maintenance. However, due to multifarious and excessive tolls, coupled with a total lack of trained engineers and poor management, this system, in the beginning at least, became so offensive to the public that active opposition took place in all parts of the kingdom, often resulting in very serious riots.

Regarding the condition of these roads, Young pictures it as follows:

"To Warrington. Turnpike. This is a paved road, and most infamously bad."

"From Dunholm to Knotsford. Turnpike. It is impossible to describe these infernal roads in terms adequate to their defects."

"To Newcastle. Turnpike. This, in general, is a paved causeway, as narrow as can be conceived, and cut in perpetual holes, some of them two feet deep, measured on the level; a more dreadful road can not be imagined; and wherever the country is in the least sandy the pavement is discontinued, and the rutts and holes most execrable."

"Of all the roads that ever disgraced this Kingdom in the very age of barbarism, none ever equal that from Billericay to the King's Head at Tilbury. It is for near twelve miles so narrow that a mouse cannot pass by any carriage."

In direct contrast to this report, we have that of Daniel Defoe, which states that

"The benefits of these Turn-pikes appears now to be so great, and the People in all Places begin to be so sensible of it, that it is incredible what effect it has already had upon Trade in the Countries where the Roads are completely finished;"

and that of Henry Homer which informs us that

"Everything wears the face of Dispatch; every Article of our Produce becomes more valuable; and the Hinge, upon which all these Movements turn, is the Reformation which has been made in our Public Roads."

Although no permanent improvement resulted from the Turnpike Acts, there is no doubt but what the turnpike system was of economic and social benefit. Opposition on a large scale could hardly have existed since Cresy reports that, up to 1829, 20,000 miles of highways in England and Wales were operated by 1,100 Turnpike Trusts, which were private companies operating under government supervision. Most of these trusts ceased to exist after the introduction of the railroad.

Throughout the entire history of Europe, from the fall of Rome to the beginning of modern road construction in France under Tresaguet, we perceive a constant attempt to improve communications. Adverse as is much of the information that we have about roads, it must not blind us to the fact that a very considerable amount of trade and travel moved constantly over these roads. Compared to the magnificent highways of the Roman engineers, they were indeed deplorable; but wars and plagues and famines all took their toll of human life during this period, and the road, like its master, suffered a precarious existence. Yet, from out of the cloud that was the Dark Ages,

we see man stumbling over his unkept roads to glide, finally,
over smooth highways into a higher civilization than he had
heretofore experienced.



BETTMANN

Building a road between two cities (Flemish miniature, fifteenth century)

PIONEERS OF MODERN ROAD CONSTRUCTION

Give me a road to build, whereon man may walk,
his mind free to look into the future, instead
of upon his feet;
Give me a road to build, a scroll upon which
History, writing the changing story of Man,
may record the doings of my generation.

PIONEERS OF MODERN ROAD CONSTRUCTION

Lost in the glamour of incessant struggle for mastery over the trade routes of the world, and hidden under the names of rulers carved large on the scroll of History, the engineer has lived and wrought and died an anonymity; yet, though his name be unknown, his work stands imperishable for all time, for though the structure itself may turn to dust, his ideas live on for those who follow to use and perfect for a greater service. Of the ancient engineers who made the roads of the world, nothing is known, and it is only with the beginning of modern road building that we are able to select those whose work was outstanding in character. The three pioneer highway engineers whose work is preeminent in this field are Tresaguet, Telford and MacAdam.

TRESAGUET

Tresaguet, the real father of modern road construction and maintenance, has received far too little credit for the splendid work he performed in reestablishing road building and systematic maintenance once more on a scientific and economical basis. Unfortunately, so much stress has been placed upon the importance of Telford and MacAdam by English and American authors, that the splendid work performed by this great French engineer has received but scant consideration, although his work preceded that of the other two pioneers of modern road building by forty years. From 1764, the date of his assignment

Chief Engineer in the District of Limoges, until his death in 1796 at the age of eighty years, Tresaguet remained the foremost authority in Europe on road construction and maintenance. Although his activities were greatly restricted by his illness shortly after 1785, his great worth was recognized by the nation, which awarded him a pension of 3000 francs. However, due to the Revolution, this pension was reduced considerably, so that, unlike Telford and MacAdam, he was, at the time of his death, reduced to the direst poverty. It was not that he was no longer esteemed, but because any kind of an existence was precarious during this period, and the very fact that one lived at all was sufficient reason for dying.

Prior to the introduction of Tresaguet's method, the Roman method of road construction, considerably modified, was used in France from the 17th century to 1775. The Roman method, used during this period, is described in the 'Descriptive Catalogue of The Road Models of the Office of Public Roads (U.S.) as follows:

1. Flat earth foundation.
2. Stone foundation composed of flat stones laid by hand in two or more layers. The total width was from 9 to 10 inches.
3. Layers of small stones which were broken in place with hand hammers.
4. Finished surface composed of stones broken by hand into sizes smaller than the underlying material. It was left to be consolidated by traffic. The total thickness of the road in the center was from 18 to 20 inches.

The adverse features of this method were an undrained or improperly drained foundation and haphazard maintenance, which

resulted in failure of the broken stone to bind adequately to prevent rutting.

The Tresaguet Method, adopted as the standard throughout France from 1775 to 1830, at which time the MacAdam Method became generally accepted, was according to the same source as follows:

1. Earth foundation parallel to the finished surface.
2. Stone foundation composed of flat stones laid on edge, lengthwise across the road, and beaten to an even surface. The depth of this foundation was about 5 inches.
3. Small stones laid and beaten by hand hammers. The finished layer was composed of broken stones about the size of walnuts and spread with a shovel.
4. The finished road when consolidated by travel had a crown of 6 inches, the width 18 feet, and the total thickness about 10 inches.
5. The curbs were of rough, flat stones, set on edge. The upper edge was made flush with the surface.

Tresaguet proposed this method in 1764 and in his own words specifies that

"The bottom of the foundation is to be made parallel to the surface of the road. The first bed on the foundation is to be placed on edge, and not on the flat, in the form of a rough pavement, and consolidated by beating with a large hammer, but it is unnecessary that the stones should be even one with the other. The second is to be likewise arranged by hand, layer by layer, and beaten and broken coarsely with a large hammer, so that the stones may wedge together and no empty space may remain. The last bed, three inches in thickness, is to be broken to about the size of a walnut with a small hammer, on one side on a sort of anvil, and thrown upon the road with a shovel to form the curved surface. Great attention must be given to choose the hardest stone for the last bed, even if one is obliged to go to more distant quarries than those which furnished stone for the body of the road; the solidity of the road depending on this latter bed, one cannot be too scrupulous as to the quality of materials which are used for it."

Tresaguet is also credited with being the first to propose and put into effect the first organized system of road maintenance. His system is the forerunner of the present-day system of maintenance and the administrative structure of his plans forms, to a large extent, the basis upon which modern maintenance forces operate.

TELFORD.

Telford, by far more versatile than either Tresaguet or MacAdam, excelled them both in scientific acumen as applied to engineering. Whereas these two confined their efforts to the field of highway engineering, Telford not only mastered this phase of work, but had already an established reputation throughout Europe as one of the outstanding authorities in bridge and canal design and construction, in addition to a substantial reputation as a designer and erector of buildings. His reputation as a builder of bridges alone should suffice for one lifetime, for it was in this that his audacity of design and his courage and ability to bring into being that which he first built in his mind, so completely freed bridge construction from the slough of mired-down conventionalities, that the design of bridges took on aspects of grandeur and originality not heretofore displayed during the renaissance of engineering science.

Telford carried on his work in the field of highway construction with the same high purpose, the integrity, the usual scientific approach to the problem in hand and the conviction that only the best was good enough, that characterized his

entire professional career. Although he built roads throughout the kingdom, performing exceptional work in the mountainous sections of Wales and in the north of England, Telford's greatest single piece of work was his construction of 920 miles of roads in the rugged Highlands of Scotland, which included the building of 1117 bridges.

Prior to this time there existed in Scotland a system of roads built by General Wade, but since they were built primarily for military purposes, they were of small value commercially, since connections were made between strategic positions rather than centers of commerce. The enforced idleness and miserable condition of the population led to the assignment of Telford, in 1802, to make a survey of conditions in the Highlands and propose recommendations as to how these conditions might be alleviated and improved. His first recommendation was the absolute necessity of improving intercourse by means of roads and bridges. The five proposals, of which the road program was the first, were submitted by Telford with the statement that

"they will not only furnish present Employment, but promise to accomplish all the leading Objects which can reasonably be looked forward to for the Improvement and future Welfare of the country, whether as regards its Agriculture, Fisheries or Manufactures."

As a result of Telford's recommendations, Parliament passed an Act in 1803 to provide

"for constructing such Roads and Bridges in the Highlands of Scotland, as shall appear to be most immediately necessary for opening extensive Communications through that part of the United Kingdom, whereby its Fisheries may be encouraged, and the Industry of its Inhabitants greatly promoted."

It is to be noted that Telford considered the work as a

whole in the light of an engineer's full duty to society, not alone for the technical and economical problems presented by its engineering aspects, but also as to its immediate and future effects upon the social and political structure of the territory involved.

Regarding these roads, which took 18 years to complete at a cost of £450,000 in Parliamentary grants alone, and performed under 120 contracts without a single instance of recourse to court action, Gregory states that

"They revolutionized the condition of the Highlands. They enabled the first stage-coach to run in 1806 from Perth to Iverness; a regular service was established in 1811. Carts and ploughs were introduced into parts of Scotland where they had never been used before.

"Telford was especially gratified at the educational effect. He employed 3200 men a year, and as the work moved throughout the country a quarter of them left every year. Hence a large number of men in all parts of the Highlands were taught the use of tools and trained in regular labour."

The extent to which conditions in the Highlands were improved, educationally and economically, is stressed by Telford himself, who stated that

"At first, they could scarcely work at all; they were totally unacquainted with labour; they could not use the tools. They have since become excellent labourers, and of the above number (3200 men a year) we consider that about one-fourth left us annually, taught to work. These undertakings may, indeed, be regarded in the light of a working academy, from which eight hundred men have annually gone forth improved workmen. They have either returned to their native districts with the advantage of having used the most perfect sort of tools and utensils (which alone cannot be estimated at less than ten per cent. on any sort of labour), or they have been usefully distributed through the other parts of the country. Since these roads were made accessible, wheelwrights and cartwrights have been established; the plough has been introduced, and improved tools and utensils are generally used. The plough was not previously employed; in the interior

and mountainous parts they used crooked sticks, with iron on them, drawn or pushed along. The moral habits of the great masses of the working classes are changed; they see that they may depend on their own exertions for support; this goes on silently, and is scarcely perceived until apparent by the results. I consider these improvements among the greatest blessings ever conferred on any country. About two hundred thousand pounds has been granted in fifteen years. It has been the means of advancing the country at least a century."

According to the 'Descriptive Catalogue of The Road Models of the Office of Public Roads (U.S.), the telford road as constructed during the first period, which began about 1820, consisted of:

1. Flat earth foundation from 16 to 20 feet wide.
2. Telford base composed of stones about 7 inches in depth. No stone more than 3 inches wide was placed at the top.
3. Top course, about 7 inches thick at the crown, composed of hand-broken stone, no heavier than 6 ounces, and passing through a circular ring not larger than $1\frac{1}{2}$ inches in diameter.
4. The finished road was bonded with 1 inch of gravel. The crown was made 6 inches from the road which was surfaced to a width of 18 feet.

Specifications were drawn up by Telford for all of the roads which came under his direction and were quite complete in every detail. An excerpt from those for the Glasgow-Carlisle Road, for example, specifies that

"The metalling to consist of two beds or layers, viz., a bottom course of stones, each 7 inches in depth, to be carefully set by hand, with broadest end downwards, all cross bonded or jointed, and no stone to be more than 3 inches wide on the top. These stones to be either whinstone, limestone, or hard freestone; the vacuities between to be carefully filled with smaller stones packed by hand, so as to bring the whole to an even and firm surface.

"The top course or bed to be 7 inches in depth, to consist of properly broken stones, none to exceed 6 ounces in weight, and each to pass through a circular

ring $2\frac{1}{2}$ inches in diameter in their largest dimensions. These to be of hard whinstone, the quality of both bottom and top metal to be determined by the inspector. Over the upper bed or course of metal to be a binding of gravel of 1 inch in thickness upon an average; the cross section of the finished roadway to have a curvature of six inches."

Proper maintenance of roads was considered by Telford equally as important as their construction. Here as in the building of the roads he insisted that thoroughness and absolute conformity to the best practices be followed in order that the road might at all times be made serviceable and the cost of repairs be kept at a minimum. This is clearly brought out in the following rules which Telford prepared in 1820 for the proper maintenance of the road between London and Shrewsbury:

General Rules for Repairing Roads

I Shape or Cross Section

Rule 1. - Upon a road of 30 feet in width, the sides should be 9 inches (later modified to 6 inches) below the surface of the middle. The best line of the cross-section is a segment of a flat ellipse. This shape not only assists the water to pass from the centre towards the sides, but contributes to the drying of the road by allowing the action of the sun and air to produce a great degree of evaporation. Surveyors ought to use a level in giving roads a proper shape, in order that the surface may be one of uniform curvature, without the smallest deviation in any one spot from the prescribed line of the cross section.

II Drainage

Rule 2. - All ditches ought to be on the field side of the road fences, and to be connected with the natural water-courses of the country.

The stone cross drains and culverts which pass under the road should be numerous, and continued through under the fences into the ditches.

In order to keep a road perfectly dry, openings of mason-work should be made from the side drains of the road into all these cross drains, to carry off the water collected from the surface of it. The bottom of these cross drains must be well paved, particularly at these openings.

It ought never to be forgotten that in order to have the surface of a road perfect, it must be kept completely dry.

All land springs ought to be carried from the side of the road by under-draining.

III Trees and Fences

Rule 3. - It is absolutely necessary to remove trees from the sides of roads, and to keep the fences under 5 feet in height. Not less than 20 per cent. of the expense of repairing roads is incurred by the trees and the improper state of fences keeping the roads wet, and by that means occasioning the rapid destruction of the materials.

IV Materials

Rule 4. - Where the materials are quarry or field stones, the hardest part of them should only be used. Each stone should be so broken that it may, in its largest dimension, pass through a ring $2\frac{1}{2}$ inches in diameter. Hammers with slender handles, light and well-steeled, must be made on purpose for breaking them. This work ought always to be done by measure, either at the quarries or in proper recesses made for the purpose on the sides of the road. Men who are past hard labour, and women and boys may be employed on it.

Rule 5. - Where the materials consist of gravel, the stones only which exceed $1\frac{1}{2}$ inch in size should be taken from the pits for the repairing of the middle part of the road, of 18 feet in breadth. These ought to be raked together as the gravel is thrown up by the workmen. This process will, in most cases, save the expense of riddling and washing the gravel. The small gravel and gravelly portions of the pit may be used for the sides of the roads and the footpaths. Every gravel stone which exceeds $1\frac{1}{2}$ inch in size ought to be properly broken, either in the pits or in the aforesaid recesses. A pronged shovel should be used in putting the stones into barrows. Surveyors should pay very particular attention to this rule, because the common use of a mixture of round gravel and clay is a public nuisance, and must be got rid of. When a surveyor obstinately persists in this practice, the trustees should dismiss him.

V Disposition of Materials

Rule 6. - Where a road has no solid and dry foundation, it must be constructed anew. It must be well drained, and put into a proper form. Upon the 18 centre feet of it stones must be put, forming a layer of 7 inches deep. Soft stones will answer, or cinders, particularly where sand is prevalent. These bottoming stones must be

carefully set by hand, with the broadest end down, in the form of a close, neat pavement; the cavities should be filled with stone chips to make all level and firm, and no stone should be more than 5 inches broad on its face. This proportion of a solid and level foundation is the most essential point to be secured in order to have a perfect road, and that the draught of carriages may be eased as much as possible. Over this bottoming of stones or cinders, 6 inches of stones, of a proper quality, broken to a size that will, in their largest dimensions, pass through a ring $2\frac{1}{2}$ inches diameter, must be laid. The 6 feet of the road on each side of the 18 centre feet (making 30 feet), when formed of a proper shape, may be covered with 6 inches of good clean gravel or small stone chips.

Where a road has some foundations, but an imperfect one, or is hollow in the middle, all the large stones appearing on the surface of it must be raised and broken; the 18 centre feet of it must then be covered with a coating of broken stones, sufficient to give it a proper shape, and to form a bed of solid materials of at least 13 inches in depth, to make it solid and hard.

Where a road already has a good foundation and also a good shape, no materials should be laid upon it but in thin layers, for the purpose of filling ruts and hollow places as soon as they appear. Stones broken small, as above described, being angular, will fasten together. In this way a road, when once well made, may be preserved in constant repair at a small expense.

Where the breadth of that part of a road which alone has been formed of hard materials, and over which the carriages commonly pass, is less than 18 feet, it must be widened with layers of broken stones to that breadth, first digging away the earth and forming a bed for them with pavement and broken stones, at least 10 inches deep. Near large towns the whole breadth of the roadway should be covered with broken stones.

VI Management of Labour

Rule 7. - All labour by day's wages ought, as far as possible, to be discontinued. The surveyors should make out specifications of the work of every kind that is to be performed in a given time. This should be let to contractors, and the surveyors should take care to see it completed according to the specifications before it is paid for. Attention to this rule is most essential, as in many cases not less than two-thirds of the money usually expended by day labour is wasted.

It is to the credit of Great Britain and the world that the
 rth of this great engineer was recognized throughout his

whole life and even in his death, for his body lies in Westminster Abbey, the only engineer to be so honored. His professional career can justly be considered as a living example of the qualities so necessary to the engineering profession in its vitally important service to society. With what high esteem Telford's work was looked upon by his contemporaries is set forth in a report by the Select Committee of the House of Commons on the construction of the Shrewsbury-Holyhead Road, which follows:

"The professional execution of the new works upon this road greatly surpasses anything of the same kind in these countries.

"The science which has been displayed in giving the general line of the road a proper inclination through a country whose whole surface consists of a succession of rocks, bogs, ravines, rivers, and precipices reflects the greatest credit upon the engineer who has planned them; but perhaps a still greater degree of professional skill has been shown in the construction or rather the building of the road itself. The great attention Mr. Telford has bestowed to give to the surface of the road one uniform and moderately convex shape, free from the smallest inequality throughout its whole breadth, the numerous land drains, and, where necessary, sewers and tunnels of substantial masonry with which all the water arising from springs or falling in rain is instantly carried off; the great care with which a sufficient foundation is established for the road, and the quality, solidity, and disposition of the materials that are put upon it, are matters quite new in the system of road making in these countries."

MACADAM

MacAdam seems to have taken no interest, at least publicly, in the study of roads and road construction until his return to Scotland in 1783 after a residence of 13 years in the United States. From 1783 to 1798 he was commissioner and trustee of roads in Scotland and devoted considerable attention to the study of local roads which came under his observation. In 1798

he moved to Falmouth and from that time onward roads not only became his hobby but his lifework. He tells us that

"In 1798 I began to make it a sort of business. Without saying to any one what my object was, I travelled all over the country in different parts, - - - as often as I had leisure and convenience down to the time I took charge of the Bristol Roads, or about the latter end of 1815. I found that the roads were extremely bad in all parts of Great Britain as far back as 1798, and that very little improvement took place in them between then and the year 1815, which I attribute to the ignorance of the persons who had charge of them, the ignorance of the surveyors, the total want of science. I found the materials so applied that the roads were all loose, and carriages, instead of passing over the roads ploughed them; that was the general fault of the roads; and the loose state of the roads, I apprehend, was owing to the bad selection of materials, the bad preparation, and the unskillful laying of them."

The macadam road completely revolutionized road building, not only in the method of construction, but it also decreased the actual cost of both construction and maintenance, which heretofore had been a serious hindrance in all countries.

MacAdam's theory was that the soil itself was entirely capable of sustaining any loads imposed upon it, provided that suitable materials were properly prepared and placed. This innovation was contrary to all established principles, practiced by the Romans and modified by Tresaguet and Telford, that the soil was incapable of sustaining the load and therefore required the placement of a costly stone foundation before a wearing surface was applied.

MacAdam's theory, as set forth by himself in 'Remarks on the Present System of Road Making', is as follows:

"The roads can never be rendered - - - perfectly secure, until the following principles be fully understood, admitted, and acted upon: namely, that it is the native soil which really supports the weight of traffic; that

while it is preserved in a dry state, it will carry any weight without sinking, and that it does in fact carry the road and the carriages also; that this native soil must previously be made quite dry, and a covering impenetrable to rain, must then be placed over it, to preserve it in that dry state; that the thickness of a road should only be regulated by the quantity of material necessary to form such impervious covering, and never by any reference to its own power of carrying weight.

"The erroneous opinion so long acted upon, and so tenaciously adhered to, that by placing a large quantity of stone under the roads, a remedy will be found for the sinking into wet clay, or other soft soils, or in other words, that a road may be made sufficiently strong, artificially, to carry heavy carriages, though the subsoil be in a wet state, and by such means to avert the inconveniences of the natural soil receiving water from rain, or other causes, has produced most of the defects of the roads of Great Britain."

So drastic a departure from the method advocated and practiced by Telford was bound to create controversy, and MacAdam was subjected to considerable ridicule. The method of construction proposed by MacAdam seems to have already been successfully used in other countries than England prior to this time for an article appeared in the Westminster Review in 1825 which stated that

"The name of Mr. McAdam deserves a few remarks for other than its present popularity. The public naturally took him as some sort of a magician, and his invention, as it is thought, as something preternatural. If his own name had not been macadamized into a verb, it is probable that his roads would have been little known. He did not invent the method in question of breaking stones, because it had long been the practice of Sweden, Switzerland, and other countries, as was long known to every observing traveller."

Parnell tells us that

"The Swedes have long had the character of being excellent road engineers. Good rock is very generally met with in Sweden, and they spare no pains in breaking it small; their roads are spacious and smooth."

Earle contends that

"Similar roads - - - had been made in Pennsylvania long

before they were laid in England, and had been tested ; and without doubt McAdam simply followed methods he had seen successfully used in America."

Aside from the contention that he may not have invented it, this method of construction gradually gained in popularity and before long was adopted throughout most of the progressive nations and established a new era of road construction. The fact that the issue became so controversial was greatly beneficial for the more it was discussed the more it became generally known. Full credit is most certainly due MacAdam for by his indomitable energy and zeal in trying to establish a better and more economical type of construction, his complete unselfishness in gratuitously giving both his time and his money to further his cause, he undoubtedly revitalized road building and made the public conscious once more of the vital necessity of building and maintaining good roads.

According to information contained in the 'Descriptive Catalogue of The Road Models of the Office of Public Roads (U.S.)',

"The chief features of MacAdam's construction were a raised, thoroughly drained, and crowned earth foundation, stone broken to uniform size not to exceed $1\frac{1}{2}$ inches, and the addition of no binding material to the broken stone. MacAdam also insisted that the road should have a slight crown and that broken stone, when spread on the road, should be kept raked smooth until thoroughly consolidated by the traffic. This form of construction continued practically unchanged until the introduction of the road roller in about 1870.

"The type of road built during the first period of macadam construction, which began about 1816, is as follows:

1. Earth foundation, which was always made higher than the surface of the adjacent ground so as to facilitate the escape of water from the foundation and the surface. MacAdam did not believe that an excavated foundation was necessary.
2. Layer of hand-broken stone, with a depth of 10

inches. This stone was broken to size weighing 6 ounces, and no stone was permitted to exceed $1\frac{1}{2}$ inches in its greatest diameter. The surface of the road was raked regularly during the process of consolidation.

"The finished road was from 16 to 18 feet wide. The crown was just enough to shed water - that is, from 4 to 6 inches. MacAdam contended that the stones would lock or bond by virtue of their angularity and so make a water-tight crust, and that it was neither necessary nor desirable "to bond a road with earth, clay, or other material that would imbibe water or be affected by frost." The surface of the road was kept even and smooth by the addition of fresh material where necessary. This material was placed on the road in thin layers in damp weather in order that the new material might more readily bond and incorporate with the old."

Not only was MacAdam zealous in promoting his scheme for road betterment, but he insisted that construction be carried out with the greatest degree of precision. This is brought out by Dupin who states that

"M'Adam's plan consists in breaking into small pieces the stones which are employed in constructing and repairing the roads. This operation is performed by women and children, who sit down and break the stones with small hammers. No fragment of stone measuring more than an inch longitudinally, or weighing more than six ounces, is laid down on the road. For ensuring the observance of this rule, the people who break the stones are furnished with sieves made of iron with circular holes, similar to those used by shot manufacturers for ascertaining the calibre of bullets. Every piece of stone that will not pass through this sieve is laid aside. Besides this instrument, Mr. M'Adam furnishes all the overseers of the work with a balance and a weight for weighing two or three of the largest fragments of each heap of broken stone, to ascertain that none exceed the specified weight."

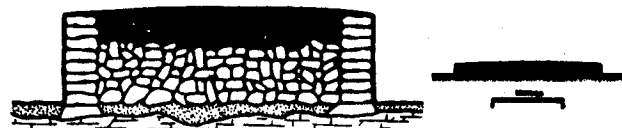
ANCIENT AMERICAN HIGHWAYS

"So Ucan made his kingdom become so large, that in order to join his cities he had to build large paved roads from one to another. In order to do this, it was enough for him to go straight through the forest carrying on his shoulders a special stone, from which, like a ribbon, the white road kept unrolling itself as the king walked. So he built many roads which went to all parts."

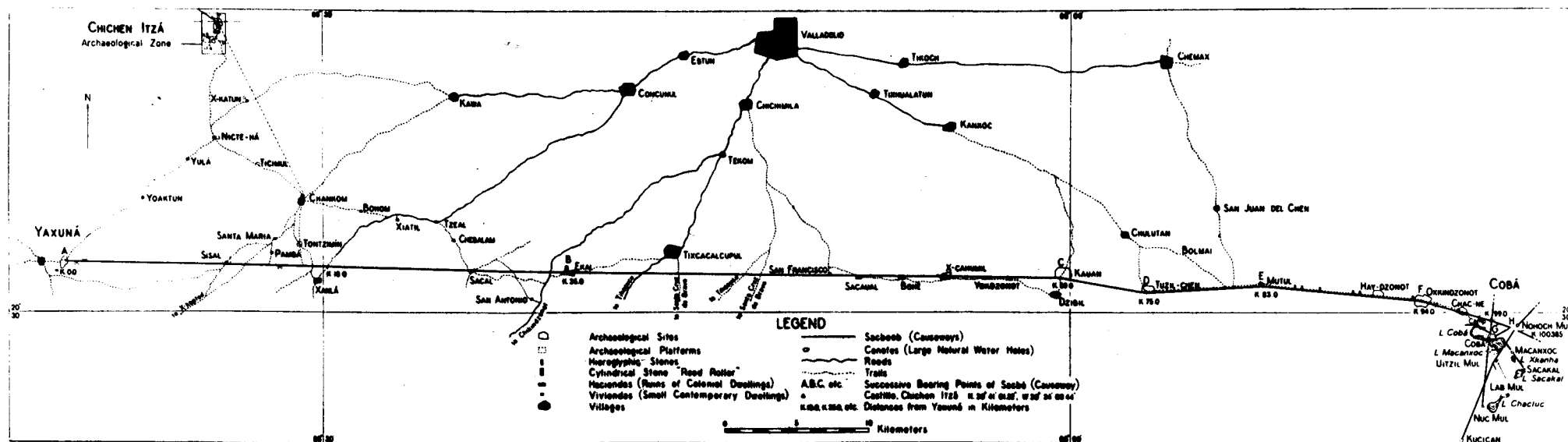
Legend of the Maya

ANCIENT AMERICAN HIGHWAYS

Our minds have for so long been imbued with the 'Grandeur that was Rome' and the 'Glory that was Greece', that we have paid scant heed to a 'Grandeur' and a 'Glory' that existed in America, comparable in many respects to that represented in our classical studies of antiquity. That a very high type of civilization did exist among the Indian Nations of Mexico, Central America and South America has been known to us since the days of the Spanish conquests, but so grandiose were the descriptions of the splendors of these civilizations that we have been prone to accept them as press-agentry on the part of swash-buckling adventurers. Diligent research, however, continues to bring forth new evidence that the Spaniards really did have something quite worth while to write home about. The discoveries of these various expeditions have been very credibly presented in scientific publications, but it is indeed unfortunate that they have not received the justice due them in the realm of public knowledge. The advancement of civilization is quite understandable in the Ancient East, where the diffusion of knowledge was made possible through racial contacts, but it is quite astonishing to the conceit of our ignorance, that there could and did exist here in America, ancient empires of power and splendor entirely independent, as far as is known, of the civilizations of the Ancient East.



a, Cross section of Road showing mode of construction. Similar diagram to the right shows the construction in true proportion.



A, Map of the Yucatan-Cuba Causway.

MAYA ROADS

One of the anomalies of history has been our almost total lack of knowledge of one of the greatest people to inhabit the earth. Where the Maya came from and what the cause was of their disembodiment from the rest of mankind, still remains one of the most intriguing of mysteries yet to be solved. We are just now beginning to get an inkling of the grandeur and scope of their civilization. The development of this civilization in the hot, miasmatic, lowland regions of Yucatan, Guatemala, and Honduras against highly adverse conditions was worthy of a nobler fate than that of extinction. Morley, an authority on Mayan history, believes that

"With consideration for the limitations of their facilities, the Maya were the greatest race that ever lived on earth."

The Maya, like the Incas, had a marvellous system of highways, but the roads of the Maya seem to have been constructed at a much earlier period, for all were already abandoned at the very beginning of the Conquest, and they must have been in a very bad condition since hardly any mention is made of them by the Spaniards. Had they been in a good state of preservation, the Spaniards would in all probability have described them as enthusiastically as they did those of the Incas, for according to tradition, they were wonderful to behold.

It is only recently that any definite and detailed information concerning Mayan roads has become known to us. The references which we do have from Spanish sources are scant.

Alonzo Davila, according to Oviedo, while traveling from Chiapas to Champoton between 1530 and 1531, came upon a fine road, at a distance of one league from Macaclan. This road, by which he entered the city, was broad and level and well swept. He also recounts how, after struggling through a marshy, thickly wooded country, the party finally came out on some fine broad plains and there rejoiced at seeing many different roadways which traversed the country in varying directions. Diego de Landa, in 1566, saw signs of there having been a very beautiful causeway in the vicinity of Tiho and Izamal. Bernardo de Lizana wrote in 1610 that pilgrimages were made from all parts to the important religious center at Izamal, and so great was the concourse of people during these pilgrimages that four roads or causeways had been made to the four cardinal points. These roads, he asserts, reached to all the ends of the land, and passed to Tabasco, Guatemala and Chiapas; and that in his day there could still be seen in many sections, pieces and vestiges of the roads. Father Joseph Delgado, while on his way from Cahabon to Bacalar in 1695, had the misfortune to encounter some renegade Englishmen, with the result that he was graciously permitted to proceed on his way, minus everything but his underwear. He finally reached Bacalar and informs us that he

"followed roads through the swamps, which had been built in ancient times, and still were well preserved."

Stephens visited Yucatan in 1842 and quotes passages from a report written by the Cura of Chemax. Concerning the then unknown city of Coba, this report states that there was a calzada or paved road, of ten or twelve yards in width, leaving the

city in a southeasterly direction, presumably towards Chichen Itza. Charnay, in 1880, inspected Comalcalco and

"noticed thick layers of cement, the remains of the old Indian road which connected this city with Rio Seco. We crossed rivulets formerly spanned by bridges, of which bricks and a corbel vault are still visible."

He goes on to report that

"In the city of Palenque we found bridges and roads connecting the various edifices, and I found one bridge of thirty-two feet square with one single opening, 3 feet 6 inches by 9 feet 9 inches deep. All were built of uncemented stones. Most bridges have crumbled away."

Blom, who made a three months survey of the ruins at Palenque in 1923, verifies this statement in reporting that

"In the heart of the main part of the city is a bridge built in the shape of a "Maya arch" over a stream. During the survey I found several similar bridges, and in some cases I found huge stone buttresses on either side of a stream, indicating that a bridge of logs once had rested on these buttresses. Locating these bridges from the Michol made it easy to connect them on the ground. Slight excavation revealed the surface of a paved road connecting the bridges."

Charnay also found marks of a cemented road from Izamal to the sea facing the island of Cozumel.

Since the Mayan civilization had already entered a period of decadence at the time of the Conquest, we have no written record of eyewitnesses as was the case with the Incas and the Aztecs. Only by the light of painstaking research, which is slowly penetrating the darkness of our ignorance, are we now beginning to realize the greatness of the Maya, who were undoubtedly the most civilized of the native people of the American continent. The pathetic part of all this research is that the Maya did have an untold wealth of existing records, until it was destroyed by the religious fanaticism of the

Conquistadors, so thoroughly that even the glyphs that were as much a written language as our own, cannot today be read. One writer has rightly described this destruction as a super-tragedy of intolerance.

There seems to be no doubt, and time will substantiate the truth of it, that the entire Mayan Empire was interlaced with a network of paved roads of a very high type of construction. These roads were known as 'sacbeob' or 'white roads' from their appearance, resulting from the surface treatment of fine sascab, a soft limestone conglomerate used in making mortar. The important roads were from twenty to sixty feet wide and all of them were built several feet above ground. The sides were built up vertically of large squared rocks laid in mortar, and between these was spread graduated layers of rock from large ones at the bottom to crushed or broken stone at the top with a wearing surface of mortar. The sacbe ran for miles straight through the jungles on tangents of such length as are seldom attempted at the present time.

Maler, while traveling from Chemax to Coba in 1891, encountered

"the ancient royal road of the Maya, the sacbe which, joining all the principal cities of the country, Nohpat, Uxmal and Cabahau, goes through Izamal to Chechen and Coba and from here, it may be supposed, to Tulum and the port of Cozumel, to whose famous temples many pilgrims are accustomed to come. This marvellous road, much ruined in the portions which pass through inhabited country, is preserved almost intact, although of course overgrown with large trees in those lonely spots where the hand of man has not been seen. It is five or six meters broad, and its roadbed, which is edged on both sides with large dressed stones, is for the most part about 75 centimeters above the natural level of the ground. The name 'sacbe' which the natives

today give to these ancient roads seems to indicate that anciently the roadbed was covered with a thick layer of mortar, at the present time broken up and destroyed by the roots of the trees."

Morley reports that during the construction of a railroad in Guatemala by the United Fruit Company, between 1910 and 1912, excavations near the prehistoric city of Quirigua revealed, one meter down, a magnificent causeway of cut stone which apparently connected the city with some unknown point to the north-east.

One of the roads which seems to have attracted the interest of a number of explorers is the main road leading westward from Coba. It was thought for a long time that this highway terminated at Chichen Itza, but it has been definitely determined by Villa that the terminus was Yaxuna, twenty kilometers southwest of Chichen Itza. Gann and Crandall of the Carnegie Institution traveled over this sacbe for sixteen kilometers in 1926 on their way to Coba; followed by Thompson, who inspected several kilometers and reported that

"The roadbed consists of the typical loose fill of the ancient Maya, that is to say of large unworked stone. On top there is a layer of smaller stones reinforced with a mixture of lime plaster and sascab, and on top of this a typical surface of lime plaster and sascab, which looked almost like cement. Of course, at the present time the surface has been almost entirely destroyed. The road was edged with walls of stones roughly squared and of about the same size. It is likely that these walls were covered with plaster anciently, but today there remains not a trace of it."

Bennett and Johnson of the Heye Foundation took bearings along this road in 1930 for a distance of thirty-seven miles, ten miles of which were through dense jungles where presumably no white man had before penetrated. Bennett states that

"The rough stone, rubble base, now so visible and inconvenient for travel, was rendered smooth and white by a coating of cement, long since broken up by the heavy jungle growth and climatic conditions. So well did the ancient Maya build that it would seem feasible not long in the future for modern engineers to improve the ancient road and make it passable for automobile traffic."

The honor of definitely locating this highway throughout its entire length belongs, however, to Villa of the Carnegie Institution. The result of this survey has been published by the Carnegie Institution in a paper entitled 'The Yaxuna-Coba Causeway', and has appended to it a road map of the region. Villa began his survey, in March 1933, at a small mound situated in the center of the old city of Yaxuna, the western terminus, and traversed the entire road by means of accurate measurements and compass bearings to Coba, the eastern terminus. The distance between the two cities was exactly 100 kilometers and the course was nearly due east, never deviating more than 10 degrees from the east-west line. The road was constructed on long tangents, five in all, the two longest being 35 and 34 kilometers respectively, and the shortest being 6 kilometers. Obviously the Mayan engineers were not afflicted with political deviations.

Villa's report, considerably abridged, is as follows:

"At the foot of this stairway (the mound in Yaxuna), I placed a bench mark, from which point I began the measurement of the length of the road. The road runs, according to an observation made with a Brunton compass, at an angle of 84 degrees 30 minutes east. In order to be absolutely certain with regard to this observation, I made use of the line formed by the south side of the sacbe, and placing the compass on a tripod, observed in the glass that the marking stake, 100 meters distant, was in exact line with the two points of the instrument which determined the direction, the needle marking the zero or north point on the compass.

"The sacbe, in this first section, is 10.30 meters broad and stands 60 centimeters above the surface of the ground.

At the present time it is in such a bad state of preservation that there hardly remain even the irregularly placed and dressed stones which formerly made up the bed or filling for the paving.

"When we had advanced 8 kilometers, we encountered the first of the many distance markers or boundary stones which are found along the side of the road. The shape of this first one and of some of the others appears to have been rather regular: 2 meters long, 1.5 meters broad and 0.5 meters high. As can be seen, they differ very much from those used at the present time, which are almost conical. However, although they appear to have a certain amount of antiquity, it should not be thought for one moment that they were built at the same time the sacbe was constructed. It can be seen clearly that the stones of which they were made were taken from the road itself, which leads to the conclusion that the sacbe was already in ruins when they were erected.

"Farther on, exactly halfway between Kilometer 33 and 34, the sacbe reaches a height of 2.50 meters above the level of the ground, the greatest height attained throughout its entire course with the exception of the point at which ascends a platform, of which I shall speak later. In this neighborhood I made one of the most interesting discoveries of the whole trip. I refer to a road roller of solid stone resting upon the sacbe itself. This roller measures 4 meters in length by 70 centimeters in diameter and weighed approximately five tons. Broken into two equal parts, and in very bad condition because of the destructive action of the elements through the centuries, it is still apparent nevertheless that formerly it had been a perfect cylinder with polished surface. Its shape as well as its extraordinary size give one reason to suppose that it may have been used as a roller for leveling the top layer of sascab, which I believe formerly covered the surface of the road.

"At Kilometer 35, the sacbe turns slightly, the new bearing being 80 degrees east. At Kilometer 69 the road turns, bearing 90 degrees 30 minutes, and holds this direction for 6 kilometers when the sacbe changes its course and proceeds at a bearing of 80 degrees east to Kilometer 83. From here the sacbe continues on the bearing 89 degrees for 11 kilometers. At Kilometer 94 the sacbe turns and bears 99 degrees east.

"Exactly Kilometer 95, the road climbs over a truncated pyramid 5 meters high, the greatest height which the sacbe reaches in all its course. Beyond Kilometer 98, the sacbe, now in the neighborhood of Coba, crosses another paved road which runs north and south to a destination as yet unknown. From here the sacbe runs 103 degrees east and ends 385 meters beyond Kilometer 100 in the large plaza known by the name of Nohoch-Mul. Its dimension at this end differs very slightly from those noted on the western end; 9.80 meters broad and 60 centimeters high.

"It may be added that although the sacbe follows the natural ups and downs of the country, it has an average height of 75 centimeters. Its state of preservation is equally bad throughout its course. Great cavities made in its surface by the knotted roots of fallen trees show how the road was constructed. Large undressed stones form the bed, on which is spread a layer of smaller stones mixed with coarse sascab and, on top of this, another layer of fine sascab, of which only a few traces remain. Its sides are vertical and are made up of larger stones, roughly dressed on their exposed sides. These were probably held together by a mixture of lime and sascab, but of this scarcely a trace remains. Close to the road in many places are to be found pits or sascaberas from which it is possible that the sascab used in the paving was taken. One may also see the quarries used by the builders, as well as the blocks of cut stones which they prepared but did not use."

Extensive ruins at numerous places along this highway indicate the existence of large and important prehistoric cities, which were probably contemporaneous with the terminal cities. Because of the presence of these ancient sites in the neighborhood of the sacbe, Villa finds it difficult to account for the lack of tributary roads. This, however, does not prove them to be non-existent since they may be, here as elsewhere throughout the lands embraced by the Mayan Empire, hidden by jungle growth, or completely buried under an alluvial deposit.

It is interesting to note that a number of legends exist to this day among the natives regarding the builders of these ancient highways. The builders, by whatever name they were known, were always rulers of great virtue and sanctity. One of these, King Ucan, got along wondrously well with his great works until confronted by the eternal Eve. Villa cites this little-known legend, which was transmitted to him, as follows:

"In very ancient times when they built the houses of Chichen Itza and the other cities, the remains of which we see today among the forests, there lived a very

powerful king named Ucan, who was allowed to do many things because he was really a holy man. He lived absorbed in his work, removed from contact with women, whose favors he refused. So he made his kingdom become so large, that in order to join his cities he had to build large paved roads from one to another. In order to do this, it was enough for him to go straight through the forest carrying on his shoulders a special stone, from which, like a ribbon, the white road kept unrolling itself as the king walked. So he built many roads which went to all parts. But it is said that on a certain occasion when he was laying the road which should join Chichen Itza with the villages to the south, there appeared to him a very beautiful princess. She began to call to him, saying, 'Ucan, come here. Ucan, turn your face toward me,' but King Ucan continued his great work without paying attention to her. The Princess, however, was stubborn, and not yielding to his indifference, interposed herself in the king's path. When he saw her beauty, he forgot for a moment his holy way of life, and letting the stone fall to the ground, entirely gave himself up to making love to the beautiful vision. This was the fall of the king. For they say, that afterwards when he wanted to continue his road, he could not lift the stone he had been carrying because he had lost his magic powers. It is recounted also that in the paths of Campeche may still be seen the very stone with which King Ucan built his long roads."

Thompson, Pollock and Charlot of the Carnegie Institution, who made a preliminary study of the ruins of Coba in 1930, report that one of the most striking characteristics of the Coba area is the network of raised, artificial roads connecting the various groups about the lakes, and running off north, east, south and west to other more distant sites. All of these roads were constructed like the Yaxuna-Coba Causeway, and for the most part run straight as a die. These causeways ran over raised platforms, had vaulted passageways beneath them, and in some cases were built across the water.

Sixteen roads were located and described by this party, all of them in a very poor condition, and all leading to destinations as yet unknown. One sacbe starts at the northeast

corner of Lake Coba and runs to the southwest, probably to Ixil according to the suggestions offered by natives, and since pollock had seen a sacbe at Ixil it is quite possible that this is true. Another sacbe begins at Nohoch-Mul and runs eastward in the general direction of Tulum which according to legend was connected by sacbe with Coba. One of the most important roads described was that which connected the fairly large suburban site of Kucican directly with Nohoch-Mul, and indirectly through other sacbeob with Coba and Macanxoc. This sacbe crosses Lake Macanxoc, although here a great portion of it has disappeared. At one point it reaches a height of about 5 meters and at another point there is constructed underneath the road a vaulted passageway 1.32 meters wide and 1.80 meters high, large enough for a person to walk through. Another road leading to the ruins of Macanxoc must have been of considerable importance since it is 19 meters wide. Two other sacbeob were found to cross Lake Macanxoc, one of which has largely disappeared underneath the water, but the other is still standing above water for the full distance. Concerning the latter, several canals cut this sacbe, thus permitting the flow of water between the main body of the lake and a pond. At the end of the rainy season in 1930, when the lake was high, this sacbe stood about 40 centimeters above water-level. This particular road appears to have attained the greatest height of any one so far encountered, that of about 6 meters in places. On yet another road was observed the unusual presence of large stones along the sides above the road surface, which suggests a parapet

on either side.

The report compiled by this party goes on to state that

"Raised roads of stone are known to occur also in the Peten region of northern Yucatan, connecting one city with another, notably Tikal, Uaxactum and Ixkum. The comparative scarcity of examples outside of the Coba area does not of necessity mean that they form a rare type of construction. The roads are often not of sufficient height to stand out readily from the natural contour of the land, are thoroughly obscured by vegetation, and easily overlooked in the process of exploration. At present the Coba area is absolutely unique in the extent and elaboration of its system of sacbeob.

"Irrespective of any internal evidence as to the age of the roads, it appears highly improbable that work of such magnitude, and representing tremendous sustained effort, could have been accomplished in a late and decadent period of Maya history."

There seems to persist a preconceived attitude on the part of many writers of Ancient American history that the magnificent highway systems were constructed and existed purely for religious reasons. Aside from the indisputable fact that a nation cannot advance, let alone live, without adequate means of interchange for either goods or ideas, we do have evidence that the Maya were a commercial people.

The first direct contact which the Spaniards had with the Maya was with a trader. This meeting occurred during the fourth voyage of Columbus, who upon reaching the Bay Islands in the Gulf of Honduras, saw a large dugout canoe, manned by twenty-five Indians, coming towards the ship from the west. From Oviedo and Valdes we learn that

"The canoe was 8 feet wide. They had in it much clothing of the kind which they weave of cotton in this land, such as cloth woven with many designs and colors, shirts which reached to the knees, and some square pieces of cloth which they use for cloaks, calling them zuyen; knives of flint, swords of very strong wood with knives

of flint set along the edges, and foodstuffs of the country."

These Indians told Columbus of a great land to the west called 'Maiaam' or 'Ycatan'.

Cortes, in his search for the rebellious Spaniards in Honduras under Cristobal de Olid, was guided by traveling merchants and maps drawn by merchants on fibre paper. Concerning these traders, it is recorded in 'Cortes Letters' that

"One of them, who was a native of Acalan, told me that he was a trader having its principal trade in the town of Nito - - - and that there was a large traffic carried on there by merchants from all parts of the country, and that his own people of Acalan lived in a quarter of their own."

Landa informs us that

"The occupation to which they are most inclined is trading, carrying salt, clothing and slaves to the lands of Ulua and Tabasco."

Even at such a late period in Mayan history as that during the Conquest, trade was fostered and carried on in large market places. To these markets came merchants and people from all parts, traveling over the great 'White Roads' or sacbeob. The existence of these trade centers is testified to by Oviedo, who states that

"they had very large markets or plazas, with many merchants and goods; both provisions and food, as well as of all other things which are bought, sold and exchanged among the natives."

Ximenes confirms this by saying that

"The ruler took great pains that there should be held great and celebrated and very rich fairs and markets, because at these come together many things; those who are in need of something will find it there and be exchanged with those other necessary things; they held their fairs and exhibited what they had for sale close to the temples. - - - they gave maize for black beans

and black beans for cacao, exchanged salt for spices which were aji or chile - - - also they exchanged meat and game for other things to eat; they swapped cotton cloth for gold and for some hatchets of copper, and gold for emeralds, turquoises, and feathers. A judge presided over the market, to see that nobody was exploited. He appraised the prices and he knew of everything, which was present at the market."

No evidence has been found that the Mayas had written business transactions, but Landa informs us that -

"They loaned and borrowed and paid courteously without usury."

Present-day research adds slowly to our store of knowledge concerning the lives of these people whose advanced state of civilization included, as is true of any well developed culture, commerce of a high type and of considerable volume. That this is true of the Maya is brought out by Blom whose research work on the subject of their commerce, trade and monetary units reveals that trade moved over regular roads, crossing swamps and following mountain passes. Blom believes that if we had traveled over the trade routes of the ancient Maya, we would have met innumerable caravans of slaves carrying merchandise, and led by merchants, carrying palm-leaf fans in their hands as a symbol of their occupation, and with net-work bags containing their cacao-bean cash at their belts.

INCA ROADS

The magnificence and extent of the Inca Roads of Peru have justly qualified them as being one of the greatest engineering feats of history. Hardly without exception, these roads have been considered as one of the outstanding achievements of the

Inca civilization. The total extent of this road system is as yet not known to us, but that such a system did exist is indisputable from extant writings from authoritative sources and from the actual existence at the present time of portions of these roads in various sections of South America, once a part of the Inca Empire. Like all avenues of transportation, in modern as well as ancient times, these highways were of considerable import from a military standpoint, but more important still was their value to the continued flow of the life-blood of commerce, without which no nation did or can exist. That the Inca roads did have a tremendous effect upon the economic life of the empire is unquestionably established by the fact that, prior to the arrival of the white man, such a thing as famine was unknown in Peru. According to Means,

"These extraordinary arteries of an astonishing empire, these strong bonds which held to a central peg an immense cluster of varied societies, are, in reality, replete with the simplicity of true greatness; yet they have had the misfortune to inspire a greater number of silly remarks than almost anything else in the whole range of ancient Andean history - with the possible exception of the ruins of Tiahuanaco. The truth lies midway between the belittling statement of the Abbe Raynal to the effect that they were merely lines of posts intended to guide travelers and the fantastic statement of a modern imaginist to the effect that the roads leaped gaily from peak to peak and across lakes. As a matter of fact, the truth was so amazing as to render flights of the imagination pale and ridiculous, and so admirable as to give the lie direct to would-be detractors."

The Inca Empire, according to Prescott, was divided into four parts, to each of which ran one of the four great roads radiating from Cuzco, the capital. Intercourse was maintained between the numerous towns and hamlets by means of these great roads and their branches which traversed the mountain passes,

and opened an easy communication between the capital and the remotest extremities of the empire. Rivery and Tschudi tell us that

"Of all the ancient monuments whose ruins invite attention, there are none which, by their astonishing character, their immense extent, and the seemingly impossible labor which their construction demanded, impress us more profoundly than the royal roads which traversed the entire empire from South to North: the one over the heights of the Cordilleras, admirably surmounting the difficulties interposed by nature; the other descending from Cuzco to the coast, and following a route to the North. To build these roads in deserts, over shifting sands; to break in pieces rocks, to level obstacles without iron tools, and without gunpowder; without compass, to hold a line over lofty mountain regions covered with eternal frost; to fill up profound chasms bordered by frightful precipices; to make roads over rivers, lakes, and morasses; - all this would be an enterprise which, even in the existing state of knowledge and with modern instruments of labor, would be deemed worthy of the most civilized nation now on the globe."

These roads, we must remember, were not merely widened and graded pathways for human and animal pack trains; they were constructed in such a manner that the modern engineer, assisted as he is by extensive research and technical knowledge, would gladly lay claim to being the creator of such a transportation system. In fact, any of the outstanding members of the engineering profession today would realize that he had been given a stupendous task to perform, even with the assistance of modern equipment and materials, were he assigned to reconstruct the Inca highways. We must realize that the Inca engineers not only established these roads by alignment and gradient, but that they graded and drained them, and paved them to a width of from 20 to 40 feet with massive blocks of well-cut stone, sometimes as much as 10 feet in width, and over considerable

distances they surfaced the roads with a bituminous cement. Tunnels were cut through where it was impossible to surmount the peaks and suspension bridges were built across chasms which were too deep to permit the construction of causeways.

There are two main highways which have received the attention of most authors dealing with Peruvian history. One of these traversed the Cordilleras through some of the most mountainous country in the world, and the other passed through the low, sandy, level country between the Andes and the ocean. Verill, who motored over portions of the main roads and reports that the road was excellent except in spots, states that nothing we moderns have ever constructed in the line of arterial roads can equal or even approach this mountain highway that was built and was in daily use more than one thousand years ago, and which made the famed Roman roads appear like mere lanes in comparison. According to Verill, it was over 4000 miles in length and extended from Quito in Ecuador to Tucuman in Central Chile, and traversed some of the roughest, most mountainous country in the world. His belief is that it would be indeed difficult to find a route with greater obstacles to surmount or with greater problems of engineering to be solved. Verill further states that

"There were mountain ranges 14,000 to 15,000 feet in height to be scaled, canyons and abysses thousands of feet to be crossed, roaring torrents to be bridged, vast deserts to be traversed, morasses and swamps to be passed. But the Incan engineers treated all such as though they were non-existent. The road, twenty-five feet in width, was carried up the loftiest ranges by easy gradients and zigzags; where precipices barred the way the living rock was hewn away or retaining walls were built up for hundreds of feet to support the roadway.

Ravines and chasms were filled with solid masonry to form causeways; canyons and torrents were crossed by suspension bridges with immense cables of fibre or wool anchored to holes cut through solid masses of rock; peaks and cliffs were pierced by tunnels hundreds of feet in length; for hundreds of miles smooth pavements of stones were laid across burning deserts; dykes were constructed across swamps and shallow lakes; and for much of its length the amazing highway was surfaced with asphalt. At frequent intervals branch roads led east and west, the eastern roads extending to the jungles of the Amazon, and the western branches connecting with a second longitudinal road, twenty feet in width, that followed the coast line for more than 2,000 miles."

The descriptions of the Inca roads have come to us from men who actually saw them and therefore knew whereof they wrote. Some of these writers unhesitatingly compared the roads to the famed Roman roads, which they had also seen, as being equal if not superior to them. Gutierrez de Santa Clara, who saw them soon after the Conquest, claims that the roads of the Incas surpassed those of the Romans. Lopez de Gomara states that

"it was a work which, as all agree, exceeded the pyramids of Egypt, and the paved ways of the Romans, and, indeed all other ancient works."

Juan Botero Benes tells us that they were

"Works which are, beyond comparison, greater than the monuments of Egypt or the structures of Rome."

Finally the learned Humboldt, who traveled over a part of the royal road of the Incas, describes it thus:

"But what, above all things, relieves the severe aspects of the deserts of the Cordilleras are the remains, as marvellous as unexpected, of a gigantic road, the work of the Incas, which, over a length of more than 250 geographic miles, makes a communication between all the provinces of the empire."

In one place, Humboldt tells us, his party had much difficulty in making a way for the mules over a marshy piece of ground,

while, for more than a German mile,

"our sight continually rested on the superb remains of a paved road of the Incas, 20 feet wide, which we marked resting on its deep foundations, and paved with well-cut, dark porphyritic stone. This road was wonderful, and does not fall behind the most imposing Roman ways which I have seen in France, Spain and Italy. By barometrical observation, I found that this colossal work was at an elevation of 12,440 feet. - - - We have also seen most beautiful remains of ancient Peruvian roads between Loxa and the river Amazon, near the baths of the Incas, in the Paramo of Chulucanas, not far from Guancabamba, and in the neighborhood of Incatambo, near Pomahuaca."

The lower road, although overshadowed by the tremendous handicaps affecting the construction of the mountain road, is none the less a magnificent piece of work in itself. This road, because of the topography of the country traversed, which was for the most part low and much of it sandy, was constructed on a high embankment of earth. It followed the coast line for more than 2,000 miles and was twenty-five feet wide. Don Augustin de Zarrate states that this road was almost forty feet wide and was enclosed between walls of adobe from one end to the other. He considers that the construction of this road was as difficult as the mountain road since it led through valleys containing streams and heavy forests, continuing on over burning sands when it left the valleys. Pedro Cieca de Leon remarks that, although this road in his time was in many places broken up and destroyed, it yet bore marked evidence of how great a work it had once been. According to this writer there was on each side of the road a very strong wall more than a fathom in thickness. The road was perfectly clear and smooth, and shaded by trees; and from these, branches, generally loaded with fruit, hung over the road. The trees were also filled with parrots and

various other birds. Through certain sections where the quantity of the sand made it impossible for the Indians to lay the wall solidly in cement, they drove huge piles into the ground at regular intervals, properly fitted together after the manner of beams. It has previously been remarked by Verill that for hundreds of miles smooth pavements of stone were laid across burning deserts. Don Juan del Velasco informs us also that the earth supported and less stable portions were made of stone covered with a mixture of lime and bitumen in which he observed very minute stones much larger, however, than coarse grains of sand.

Bitumen was not only used as a surfacing material, but was also used as a filler between the large slabs of paving stone, and as a cementing material in the construction of causeways over chasms and fissures in the mountains. According to both Velasco and Prescott, the cohesive strength of this material was such that the rushing torrents of mountain streams had, through the ages, gradually eaten away the portion below the surface and left the superincumbent mass still spanning the valley like an arch.

Hiram Bingham, director of the National Geographic Society and the Yale University joint expedition in 1915, while exploring the ruins of the wonderful city of Machu Picchu, which he believes was probably built by the Megalithic Race that preceded the Incas, located part of an ancient road leading back from the city up the mountain side and across the face of one of the towering precipices on Machu Picchu mountains. It appeared to him to proceed in a southerly direction into a region

of high mountains, deep valleys, and well-nigh impassable jungles. The expedition located the remains of a number of roads in this section which they had no difficulty in tracing, these roads forking to various destinations. One of these highways connected Machu Picchu with Cuzco. Some of the roads were still in good condition, for Bingham states that one of the roadways, leaving Machu Picchu by way of a deep gully, was the finest example of an Inca road which he had seen; the long stretch of roadway leading up the Colpa Valley was in a remarkable state of preservation; and the other one leading into the Aobamba Valley was in such condition that the mules could follow it in safety. On all of the roads were the ruins of fortresses and taverns. Bingham states that the builders of Machu Picchu had an elaborate system of highways throughout the region between the Urubamba Valley and the Apurimac River. This whole section, of which Machu Picchu was the capital, was once a densely populated region.

Although the two main highways, previously described, have received far greater attention than any others, there did exist a very extensive system of secondary roads. Means informs us that

"Supplementary to these two major highways was an intricate network of secondary roads almost equal in usefulness. Father Cobo mentions several of them: one went from Tumbes up into the mountains; another went from Chan-Chan up to Casamarca and Chachapuya; another from Parmunca mounted to Sausa; another went from Rimac up to Sausa; and still another went from the coast up to the province of Chuqui-apu (La Paz) and thence down into Chuncho country in the Montana. These secondary roads were, therefore, transversal routes in the main. In addition to them, we may be very sure, there were infinitely numerous lesser roads reaching into every

part of the empire. Of such the road by which the citadel of Machu Picchu was connected with Cuzco, as described by Dr. Bingham, is a good example."

The various authors of Peruvian history are in agreement on the existence of taverns and store-houses along these roads, the ruins of which still remain in many instances to this day. Prescott states that caravanseries or tambos were erected all along these highways at regular intervals of from ten to twelve miles, more particularly for the Inca and his suite and for those who journeyed on public business. Pedro Cieco de Leon writes that in each of the valleys there were built grand and princely lodging places for the Incas, and depositories for supplies of the army. Lopez de Gomara informs us that the Incas had for resting places certain grand palaces which were called tambos, where the Court and royal army lodged, and that these were provided with arms, food, shoes and clothing for the troops. Humboldt verifies all this by his discovery at different places, and for the most part at equal distances, of edifices constructed of well-cut stone. He found some of these buildings provided with fortifications; others presented in their arrangement baths with conduits of warm water, and he in fact measured and made designs of some of the more elaborate buildings.

Verill, a present-day writer, tells us that there was also a complete system of sentry stations, watch towers and forts, as well as a system of signal-fires by means of which men, constantly on the watch, could transmit messages from one end of the road to the other in an incredibly short time. At the

time of the revolt at Quito, news of the uprising was transmitted by means of signals and reached Cuzco within four hours after the trouble started.

Goods and messages, according to Gregory, were carried rapidly along the roads by relays of runners over distances of from ten to twenty miles. Verill says that

"Fresh fish, caught in the Pacific, was delivered in Cuzco, over 300 miles distant and beyond 15,000 feet in height, within thirty hours from the time they were taken from the water, which is six hours sooner than is possible by the railway today. Fish from Lake Urubamba, caught in the morning, was served at Cuzco dinners the same evening, and fruits and vegetables from the coastal plains were delivered in Cuzco, the Incan capital, within fifteen hours after they were gathered."

It is quite evident that these ancient engineers had perfected a road system centuries ago of such magnitude and perfection as to humble us all in our belief of superiority in mechanical advancement, for one is led to speculate as to the wonders they might have accomplished had they possessed the knowledge which is ours today. They surpassed the road builders of the Ancient East, not alone in their genius in overcoming obstacles of such magnitude as did not exist there, but they anticipated modern engineering methods by establishing their roads by easy gradients and not by alignment alone. Unlike the vaunted straight-line construction of the Romans, which was in reality the line of least resistance, the Incas followed the more difficult method of making the gradient one of the controlling factors. Unlike the other ancient peoples, who had for centuries used the same desert routes with no surfacing other than the natural hard-packed sand, the Incas constructed

surfaced roads on embankments over their desert wastes. In fact, were these Incan roads in existence today, instead of having been destroyed as a result of the white man's insatiable lust for wealth, they would, in all probability, be suitable to modern needs, such was their advanced type of construction.

ROADS IN THE UNITED STATES

"When we consider the vast extent of territory within the United States, the great amount and value of its production, the connection of its parts, and other circumstances on which their prosperity and happiness depend, we cannot fail to entertain a high sense of the advantage to be derived from the facility which may be afforded in the intercourse between them by means of good roads and canals. Never did a country of such vast extent offer equal inducements to an improvement of this kind, nor ever were consequences of such magnitude involved."

First Annual Message - James Monroe

ROADS IN THE UNITED STATES

The land of revived hope, breaking like the dawn of a new beginning above the glowering clouds of wars and famines and persecutions, received but scant notice from the parent nations which gave of their sons and daughters to the founding of a new nation, destined so soon to rise from the mediocrity of a few scattered settlements along the sea board to the solidity of a unified people bulwarked from ocean to ocean by the spirit of individual liberty. Never before had there been engraved on the scroll of history a tale such as this to which all nations, races, creeds, and political beliefs contributed their due share through the blood stream of these same sons and daughters, opening up with their roads a land of beginning again.

The early settlements in Colonial America were confined mainly to a narrow strip along the Atlantic sea board, or along the coastal rivers, serving as pathways leading to the sea board. Each settlement, however small, was almost an entity in itself, concerned primarily with its own struggle for survival against the forces of Nature, and secondarily with whatever articles it could produce for trade with Europe; consequently, little attention was given at first to land communications. Such roads as did exist in the neighborhood of these settlements carried very little traffic and were of necessity given little or no consideration. Trade with the interior was mainly on the rivers, otherwise by trails which adequately served the

purpose of the times. The condition of the roads was undoubtedly extremely bad, yet withal, having once acquired the status of a road, they do not appear to have been much worse than those in existence in England and many other countries in Europe during this period. One can hardly expect an infant in swaddling clothes, however lusty, to walk upright like a full-grown man, when he himself stumbled as he walked.

Earle remarks that the French and English officers who served in the colonies during the Revolutionary War, La Rochefoucauld among them, praised the roads; and also that

"Mr. Ernst, an authority upon transportation and postal matters, believes that our roads in the northern provinces, on the whole, were excellent. He says that the actual cost of roads as contained in Massachusetts records proves that the notion that our New England roads were wretched is not founded on fact. He notes our great use of pleasure carriages as a proof of good roads; in 1753 Massachusetts had about seven such carriages to every thousand persons. The English carriages were very heavy. In America we adopted the light-weight continental carriages - because our roads were good."

Road building, like government, was quite individualistic, progressing from town to county to state to national jurisdiction, and even today this parallel continues for regardless of the fact that national highways traverse the various states in every direction no absolute control over them is held by the Federal Government, for title to ownership and responsibility for construction and maintenance is vested in the states, subject only to technical and administrative assistance by the United States Public Roads Administration. Cooperation, not control, has always predominated, adhering always to the cardinal principle of states rights.

Increased population, growth of trade, and a perceptible movement inland from the sea coast very early created a demand for some action being taken towards improvement of roads; however, inadequacy of laws and lack of effective enforcement kept the roads in a serious state of disrepair for many years. Page informs us that

"The first American road law was passed by the House of Burgesses of Virginia in 1632. So far as can be ascertained, the first American road built by white men was at Jamestown a few years later."

The New England Path, between Boston and Plymouth, was begun in 1639 as a result of action taken the same year by the General Court of Massachusetts Bay Colony. Finding that the existing highways

"have not been laid out with such convenience for travelers as were fit, nor as was intended by this court,"

the Court ordered that

"every town shall choose two or three men who shall join with two or three men of the next town, and these shall have power to lay out the highway in each town where they may be most convenient - - - Notwithstanding any man's propriety, or any corne ground, so as it occasion not the pulling down of any man's house or laying open any garden or orchard," also that "in common grounds, or where the soil is wet or miry, they shall lay out the ways the wider, as six, or eight, or ten rods, or more in common grounds."

The Virginia Assembly, according to Henning's Statutes at Large (1660-1682), passed an act setting forth that

"Whereas through the frequent alterations of the highwayes by falling trees over them, and many times taking them into fenced plantations to greate hindrance to travellers and traders: Be it enacted that the justices doe yearly in October court appoint surveyors of the highwayes who shall first lay out the most convenient wayes to the church, to the court, to James Towne, and from county to county, and make the said wayes forty foote broad, and make bridges where there is occasion,

and the wayes being layed out, and the bridges made they shall cause the said wayes to be kept cleere from loggs, and the bridges in good repaire that all his majesties subjects may have free and safe passage about their occasions; and to effect the same, the vestryes of every parish are enjoyned and impowered to order the parishoners every one according to the number of tithables he hath in his famile, to send men upon the dayes by the surveighors appointed to helpe them in cleereing the wayes, and making or repairing the bridges."

Durrenberger states that

"The first attempt to open roads in this section (Middle Atlantic States) were those made by the Dutch, however, little was accomplished before they were disposed by the English. Under the government established by the Duke of York in 1665 was the provision that wages should be paid and 'that no ordinary laborer shall be compelled to work from home above one week together'."

We find here what appears to be the first effective action taken anywhere to substitute wages for compulsory free labor.

Maryland passed her first road law in 1666, described as "An act for making high wayes & making the heads of Rivers, Creekes, Branches and Swamps passable for horse and ffoote", ordering therein that

"upon the 20th day of October next ensuing meete together in their respective countyes to consult of what high wayes are fitt to be made."

Another law of 1704 stipulated that

"all public and main roads were to be here after cleared and well-grubbed, fit for traveling, twenty-foot wide; and good and substantial bridges made where necessary, at the discretion of the County Courts."

Total responsibility for building of roads in Upland (Chester), Pennsylvania was placed at first upon land owners for in 1678 this court ordered that

"Every person should within the space of two months, as far as his Land Reaches, make good and passable wayes, from neighbour to neighbour with bridges where itt need, To the end that neighbours on occasion may come together. Those neglecting to forfeit 25 gilders."

The Pennsylvania Provincial Council in 1700 enacted that

"Itt was this day ordered by the Gov. & Council, yt the king's Highway or publick road, & the bridges yrin from ye town of Philadelphia to the falls of Delaware yt now are, be wt all expedition sufficientlie cut & cleared from all timber, trees & stumps of trees, Loggs, & from all other nusances whatsoever yt Ly cross ye sd way, & yt ye same, with all passages in & outt of creeks & Branches, may be made passable, commodious, safe and easie for man, horse, cart, waggon or team - - - ."

Meyer tells us that

"The South Carolina assembly made its first provision for road-building in 1682. Thereafter it gave considerable attention to providing for the building and repairs of roads and bridges.

"James Oglethorpe, in the period of his control, showed remarkable vigor in opening roads and trails. - - - In 1735 the town of Augusta was laid out by order of the Georgia Trustees and the importance of the town led Oglethorpe quickly to have a route marked out through the woods from Savannah to Augusta."

It would appear that the first move toward concerted action on the part of any colony as a whole was taken by the Colony of Georgia. Instead of placing the responsibility for road building and repair upon the individual parish or county, an act created in 1755 provided that the colony should be divided into nine districts, to each of which were assigned six surveyors whose duty it was to survey and keep in repair the roads within their respective districts and to assess a road tax on all male inhabitants within the age limits of sixteen to sixty. This act, assented to the 7th of March, 1755, was entitled "An Act to impower the several Surveyors hereafter named, to lay out public Roads in the Province of Georgia", set forth that

"We therefore humbly pray your most Sacred Majesty that it may be Enacted and be it Enacted by the Governor Council and Assembly of the Province of Georgia, and by the Authority of this same, That the Surveyors herein after named and appointed shall be, and they are hereby

impowered, to lay out such high Roads, Private Paths, Bridges, Creeks, Causeways, and Water Passages in this Province and to establish such Ferrys, as they shall think proper, for the more direct and better convenience of the Inhabitants of this Province."

We see in this act the first attempt in this country to centralize control over all roads and bridges within a colony for not only was the colony divided into definite road districts, but the

"Surveyors shall be accountable to the Governor and Council or to the General Assembly when sitting."

Hereby also was established the first embryo highway department for the surveyors were empowered to divide their districts into two or more divisions, and were ordered to meet at least twice a year to determine all matters concerning the roads and to choose a surveyor in the place of one who had died or had been removed for inefficiency or wilful neglect of duty.

Continued clamour from the public for betterment of land communications resulted in the creation of the turnpike, which was to have a vital effect upon the country for many years to come. Regarding the development of the turnpike movement, Kirby and Laurson remark that

"Following the establishment of a stable American government in 1789 came the first wave of enthusiasm for better means of communication between the various sections of the Union. The last decade of the 18th century and the first of the 19th witnessed a great improvement in land transportation in the United States, brought about by the construction of some thousands of miles of turnpike roads.

"The first important American turnpike was built in 1792-94 between Philadelphia, the metropolis, and Lancaster, the largest inland city. It was 62 miles long, 66 feet wide, covered for a width of some 20 feet with 18 inches of 'pounded' stone, and cost about \$7000 a mile. David Rittenhouse, leading American astronomer and instrument maker, had charge of the preliminary

surveys. The right of eminent domain seems to have been exercised for the first time in a wholesale and open fashion in the United States by the proprietors of this road, and a storm of protest followed."

The Lancaster Pike was evidently well built and well maintained for Francis Bailey in his 'Journal of a Tour in the Unsettled Parts of North America in 1796 and 1797' informs us that it

"is a masterpiece of its kind; it is paved with stone the whole way, and overlaid with gravel, so that it is never obstructed during the most severe season."

Disputing the contention that the Lancaster Pike was the first turnpike to be established, Earle asserts that

"The first American turnpike was not in Pennsylvania, as is usually stated, but in Virginia. It connected Alexandria (then supposed to be the rising metropolis) with 'Snigger's and Vesta's Gaps' - that is, the lower Shenandoah. This turnpike was started in 1785-86, and Thomas Jefferson pronounced it a success. In 1787 the Grand Jury of Baltimore reported the state of the country roads as a public grievance, and the Frederick, Reistertown and York roads were laid out anew by the county as turnpikes with toll gates. In 1804 these roads were granted to corporate companies."

Wood supports this claim by stating that Virginia led the way by erection of gates on the roads leading into Alexandria from Snigger's and Vesta's Gaps.

The Lancaster Pike, however, was the first of many hundreds of privately owned and controlled roads and was the first scientifically constructed road in the United States. So important did this road become that, according to Chatburn,

"In 1800 Pennsylvania fostered the construction of a system of turnpikes, by granting franchises and subscribing stock, which was eventually to cover the state and control the western market. By 1828 there had been 3110 miles of chartered turnpike in Pennsylvania costing over \$8,000,000. These thousands of miles of fine turnpike roads including many good bridges placed Pennsylvania in the lead for internal improvements. But other states were similarly employed. New York and New England

by 1811 had chartered 317 turnpikes. Virginia appropriated funds "to be used exclusively for river improvements, canals and public highways", in 1816. South Carolina voted a million dollars, in 1818, to be raised in four annual levies for similar purposes."

Public roads were, of course, built during this period, but with the exception of a few outstanding examples such as the Cumberland Road, they were hardly comparable in either construction or maintenance with the turnpikes built by private capital. This was probably due to public opinion, since having to pay for the privilege of using these private turnpikes, demands were made that they be well built and maintained. The general turnpike act of New York, for example, specified that

"the road shall be faced with gravel or broken stone to a depth of not less than nine inches, in such a manner as to secure a firm and even surface",

and usually most acts stipulated that the road

"shall be bedded with stone, gravel, sound wood or other hard substance, well compacted together, and of sufficient depth to secure a good and solid foundation."

The width of these roads varied from 18 to 28 feet, being generally 20 to 22 feet. Considerable thought had evidently been given to road surfacing for it appears that the macadam type of road was in successful use in this country quite some time before it became popular in Europe. Earle states that

"Similar roads (macadam) had been made in Pennsylvania long before they were laid in England, and had been tested; and without doubt McAdam simply followed methods he had seen successfully used in America. Among others the Salem and Boston Turnpike, the Essex Turnpike (between Salem and Andover), and the Newburyport Turnpike, all macadamized roads, were in successful operation before Telford and McAdam had perfected their systems."

All of the leaders of the infant republic fully realized the

vital need for internal improvements and seem to have given considerable thought to the necessity of providing good roads, not only between the settled communities along the sea board, but also into the interior. Madison, although overshadowed historically by such giants as Washington and Jefferson, was undoubtedly one of the most advanced thinkers of this period, and among the many pressing problems of the times that of road improvement held a place of special import, consequently his opinion in the matter may well serve to exemplify the trend of thought during the formative period of the country.

Madison early recognized the need for good roads and the important role they would play in the history of the country, for even before he had entered public service, he had given considerable thought to the subject. This is clearly demonstrated by one of his manuscripts entitled an 'Act For Opening & Keeping In Repair Public Roads'. Written in 1772, when he was but twenty-one years of age and shortly after he graduated from Princeton, the draft indicates that he had devoted a great deal of study to the matter even to the extent of doing away with statute labor for a note in the manuscript reads that "This act repeals an act requiring the personal labor of the inhabitants for repairing roads". The draft, although it never reached a maturer stage, is well worth considering in view of the period in which it was written and is quoted herewith:

Act For Opening & Keeping In Repair Public Roads

Freeholders of each Township to chuse annually two supervisors of the High ways.

The supervisors to lay a rate (appeal to lie to Quarter

Sessions for party grieved) not exceeding 9d. in the pound on real & personal estate & to last county assessment to be employed in opening, clearing, mending & repairing the several high ways within their respective Townships.

Where roads divide 2 townships, to be repaired at joint expense, and supervisors.

Vacancy in supervisorship by death refusal to act or removal to be supplied by 3 or more Justices of peace.

Supervisors to receive 12d. in the pound for collecting, & 4 shillgs. per day during the overseeing employg. & directing the workmen on the public roads.

Tenants of non resident Landlords liable for rates to be deducted from their rents, saving contracts.

Supervisors reqd. as often as roads out of repair or new roads to be opened, to have sufficient no. of labourers to work upon, open, amend, clear & repair the same in the most effectual manner, & to purchase wood, and other materials necessary. Supervisors & persons havg. his order, empowered to enter on adjoining lands, cut ditches & drains as he shall find necessary, doing as little damage as possible, which drains shall not be stopped by owner under penalty of 5 pds. for each offense - also to dig gravel sand or stones, or take loose stones on sd. land or cut trees necessary, doing as little damage as possible, & the sd. materials to remove without let, paying or tendency to owner the agreed value, or in case cannot agree, value to be set by two indifferent freeholders.

Penalty of 3/. on persons working on high way, asking demandg. or extorting money or other thing from travellers, to be recovered by supervisor before the Justice of peace & applied to use of roads, & in case of Supervisors connivance, he to forfeit 20/. to by any person whatever $\frac{1}{2}$ to prosecutor, $\frac{1}{2}$ to use of roads.

Supervisors neglecting or refusing to perform duty, to be fined £3 for every offense, to be recovered in same way before Justice of peace & applied to use of roads allowing appeal to Supervisor to Court of Quarter Sessions which on petition of party grieved shall take final order therein as shall appear Just & reasonable. Electors at time of chusing supervisors to chuse four freeholders yearly, to settle acct. of supervisors whose office shall then be about to expire: & the person or persons who shall have served the office of supervisor for preceding year, shall on 25th March yearly or 6 days after make up & produce fair accts. of all sums expended, & come to his hands: wch. accts. shall be entered in a book to be kept for that purpose, & shall be attested on oath or affirmation before Justice of peace if reqd. by sd. freeholder or 3 of them - sd. freeholders or 3 of them to allow such charges & sums only as they shall deem reasonable; money remaining in hands of precedg. supervisors to be paid by order of sd. freeholders to succeeding supervisors: in case of the reverse, succeeding supervisors to reimburse by like order, out of the first money coming to their hands - supervisors failg. to produce acct. or to pay surplusage or deliver book of acct. to successor or in his hands may on complaint by sd. freeholders to any Justice of

peace, be by him committed to county gaol, till he comply.

Person sued for executing this act. may plead genl. issue, & give it & special matter in evidence; & if dft. or prosecutor be non-suit, or suffer a discontinuance or if a verdt. pass agst. him, dfts. shall have treble costs to be recovered as in other cases of costs given to dfts. & no such complaint or prosecution tained unless comenced within six months after cause given, or unless security be first for charges.

Fourteen years later the problem is still in his mind for on June 19, 1786, the same year in which the legislature of Virginia appointed him a delegate to a convention at Annapolis to devise a system of commercial regulations for all the States, Madison replied to a letter from Jefferson, then Minister to France, as follows:

"I observe that in your analysis of the Revisal p. 251 of your notes, a Bill is mentioned for consigning our roads to undertakers (contractors) instead of the present vicious plan of repairing them. No such provision is comprized in the Road bill reported & printed. If it be any where in existence, I wish you could put me on the means of getting a sight of it. I conceive such a reform to be essential & that the Legislature would adopt it, if presented in a well digested form."

Finally, in his last message to Congress in 1816, forty-four years after the problem first took form on paper, roads were still uppermost in his mind, this time nationally, for to Congress

"I particularly invite again their attention to the expediency of exercising their existing powers, and, where necessary, of resorting to the prescribed mode of enlarging them, in order to effectuate a comprehensive system of roads and canals, such as will have the effect of drawing more closely together every part of our country by promoting intercourse and improvements and by increasing the share of every part in the common stock of national prosperity."

No single road in the whole history of the United States has been subjected to such critical research as the Cumberland

Road, or as it is known even to this day, the National Pike. It not only marked the entry of the National Government into the field of active highway construction, being the first turn-pike road to receive Federal aid, but it opened the door of the nation to a country of such vast extent and potential wealth as had never been dreamed of. This road, although historically connected with Washington, was "first laid out", according to MacDonald,

"in 1743 by the Ohio Company, a party of Virginia gentlemen who had been granted 200,000 acres on the Ohio River between the Monongahela and the Kanawha on condition that 100 families should be settled on it in two years;"

but, according to Hulbert,

"The road was probably nothing more than a blazed trail with possibly some alteration of route at certain points; it may be that in low ground which could not be avoided the road was 'corduroyed', but this is quite doubtful."

MacDonald remarks that

"It was over this road that Washington traveled, in 1753, at the behest of the Virginia Governor to inquire of the French their rights to built forts on the Allegheny River. Again in 1754, when war with the French seemed inevitable, he made the same trip over the same road, this time taking with him 300 men and possibly 10 swivel guns, to move which it was necessary to widen and straighten the road. Finally, in the following year (1755), it was over this same road that Braddock advanced from Fort Cumberland with 2200 men and 600 pioneers, leading the way, to widen and corduroy the trail for the Army. This time the road was evidently made with some care, for Washington complained that the movement of the army was being delayed because the road-makers were stopping to level 'every mole-hill'."

The first step forward towards active participation took place in 1803 when Ohio was admitted to the Union. At this time, states Meyer,

"five per cent of the net proceeds of the sale of public lands within that State were set apart for the laying out and making of roads, three per cent of which should be



1840 - THE NATIONAL PIKE

Photo by Public Roads Administration

expended on roads within the State under the direction of State legislature, leaving the other two per cent as a fund to be expended under the direction of Congress for the construction of roads to and through the State."

Definite action had its inception when a Senate committee, appointed in December 1805, recommended that a road be laid out and built

"from Cumberland on the northerly bank of the Potomac, and within the State of Maryland, to the Ohio River at the most convenient place on the easterly bank of said river opposite to Steubenville and the mouth of Grave Creek, which empties into said river Ohio, a little below Wheeling in Virginia."

Acting upon this recommendation, Jefferson, on March 29, 1806, approved "an act to regulate the laying out and making of a road from Cumberland in the State of Maryland to the State of Ohio", which provided that the proposed road was to have a right of way of 4 rods, a roadway of 20 feet, a maximum grade of $8\frac{3}{4}\%$, and a surface of stone, earth, gravel, or sand, or a combination of these. He also appointed a three-man board of commissioners to lay out the road. This board decided that selection of the route to be followed was to be governed by: (1) shortness of distance between navigable points on eastern and western waters; (2) the best method of diffusing benefits with the least distance of road; (3) a consideration of the comparative merits of towns and settlements with present and prospective populations.

Location of the road as far as Wheeling had been completed by 1811. The first contract for construction was let on April 11th of this year and about ten years later the road had been completed from Cumberland to Wheeling. MacDonald informs us that

"The total length of this section in 131 miles and the total cost of construction was \$1,706,845, or an average of \$13,029 per mile. The entire section east of Wheeling was surfaced with broken stone put down in two courses. The specifications provided that the stone for the bottom course should pass a 7 in. ring, and that for the top course, a 3 in. ring. The top course was 6 in., and the bottom, 12 in., before compacting, and as the traffic was depended upon to effect the compacting, there is little doubt that travel over the road in springless wagons was not unduly comfortable, especially as it is said that the engineers in charge of the work had a way of erecting barriers which were frequently shifted in order to prevent honest travelers from using any part of the surface after it had become compact."

More complete details as to specifications governing construction of the road are given by Agg and Brindley who state that

"According to articles of agreement made in 1811 between Albert Gallatin, Secretary of the Treasury, and the contractor for a 'certain part of the road leading from Cumberland in the State of Maryland to Brownsville in the State of Pennsylvania', the specifications for the construction of the road were in part as follows:

The trees to be cut down and cleared the whole width of sixty-six feet, according to the fourth section of the act above mentioned; the stumps to be grubbed, and the bed of the road to be levelled thirty feet in width; the hills to be cut down, the earth, rocks, and stones to be removed, the hollows and valleys, and the abutments of all the bridges and culverts to be filled, so that the whole of the road on the aforesaid width of thirty feet, to be reduced in such manner, that there shall not in any instance be an elevation in said road when finished, greater than an angle of five degrees with the horizon, nor greater than the gradation fixed by the commissioners who laid out the road, and so that the surface of the said road shall be exactly adapted to the marks or stakes, made or to be made, by the person appointed superintendent for the said road by the President of the United States - The road to be covered twenty feet in width, with stone eighteen inches in depth in the middle, and diminishing to twelve inches at the sides; the upper six inches thereof to be broken to such size that each particle thereof will pass through a ring of three inches in diameter, and the remaining or lower stratum to be broken so as to pass through a seven-inch ring."

Construction of this road was evidently of a high type and

apparently well done for Earle states that one who saw the work performed on it wrote:

"That great contractor, Mordecai Cochran, with his immortal Irish brigade - a thousand strong, with their carts, wheelbarrows, picks, shovels, and blasting-tools, graded the commons and climbed the mountain side, leaving behind them a roadway good enough for an emperor."

From Seabright we also learn that

"Its numerous and stately stone bridges, with handsome turned arches, its iron mile-posts and its old iron gates, attest the skill of the workmen engaged on its construction, and to this day remain enduring monuments of its grandeur and solidity."

Although the Cumberland Road was "destined to reach the Rocky Mountains", it was never completed beyond Springfield, Ohio. Partially completed from there to Vandalia, Illinois, and the survey projected across the Mississippi River as far as Jefferson City, Missouri, the road was finally abandoned by Congress and ceded to the various states after a total Federal allotment of \$6,828,324 had been expended upon it between 1806 and 1844.

One characteristic feature of road construction in the United States was established when the Federal Government took the first step towards active interest in the Cumberland Road and has been tenaciously adhered to ever since, namely, that States' Rights have always been respected and a national system of roads in the true sense of the word has never existed. The Cumberland Road was a political battleground between the proponents of Federal control over roads who based their contention on the Constitution which set forth that "Congress shall have power to establish post-offices and post-roads", and the

proponents of States' Rights who interpreted this power under the Constitution to apply only to the establishment of postal routes over roads already in existence and that only the State and not the Federal Government had the right to construct roads. States' Rights were respected from the first, even on the Cumberland Road, as set out by Monroe in his 'Views on the Subject of Internal Improvements' which follows:

"In this instance which is by far the strongest in respect to the expense, extent and nature of the work done, the United States have exercised no act of jurisdiction or sovereignty within either of the States by taking the land from the proprietors by force, by passing acts for the protection of the road, or to raise a revenue from it by the establishment of turnpikes and tolls, or any act founded on the principle of jurisdiction or right. Whatever they have done has, on the contrary, been founded on the opposite principle, on the voluntary and unqualified admission that the sovereignty belonged to the State and not the United States, and that they could perform no act which should tend to weaken the power of the State or to assume any to themselves."

Federal participation in the building of numerous other roads took place during the early years of the infant republic. Monroe in this same message reports that

"Many roads have been opened, of which the following are the principal: The first from Cumberland, at the head waters of the Potomac, in the State of Maryland, through Pennsylvania and Virginia to the State of Ohio. The second from the frontiers of Georgia, on the route from Athens to New Orleans, to its intersection with the thirty-first degree of north latitude. The third from the Mississippi at a point and by a route described to the Ohio. The fourth from Nashville, in Tennessee, to Natchez. The fifth from the thirty-first degree of north latitude, on the route from Athens to New Orleans, under such regulations as might be agreed on between the Executive and the Spanish Government. The sixth from the foot of the rapids of the river Miami, of Lake Erie, to the Western line of the Connecticut Reserve. The seventh from the Lower Sandusky to the boundary line established by the treaty of Greenville. The eighth from a point where the United States road leading from Vincennes to the Indian boundary

line, established by the treaty of Greenville, strikes the said line, to the North Bend, in the State of Ohio. The ninth for repairing and keeping in repair the road between Columbia on the Duck River, in Tennessee, and Madisonville, in Louisiana, and also the road between Fort Hawkins, in Georgia, and Fort Stoddard. The tenth from the Shawneetown, on the Ohio River, to the Sabine, and to Kaskaskias, in Illinois. The eleventh from Reynoldsburg, on the Tennessee River, in the State of Tennessee, through the Chickasaw Nation, to intersect the Natchez road near the Chickasaw old town.

"All of these roads except the first were formed merely by cutting down the trees and throwing logs across, so as to make causeways over such parts as were otherwise impassable. The execution was of the coarsest kind."

More important even than the Cumberland Road, as a prime factor in creating settlements in the interior and in expanding the limits of what was to become a vast nation, was the Wilderness Road, extending, as Agg and Brindley say,

"from the headwaters of the Shenandoah and the James through Cumberland Gap and across Kentucky to the Falls of the Ohio at the present site of the city of Louisville. The Wilderness Road did very much to establish the power of the white man in the western country. It broke the barrier which separated the East from the West, thus dividing the Indians in the North from those in the South, operating at the same time as a flank movement on the powerful tribes of Indians which occupied New York and Pennsylvania, causing them to give way before the advance of civilization. It opened up settlements in Kentucky, Tennessee, Ohio, Indiana, and Illinois, thus making possible one of the great major steps in the westward movement of American population."

This road for a time, it is said, actually outrivalled the Ohio River as a pioneer route.

The route was first marked out by Daniel Boone, in 1775, for the Transylvania Company, for in a letter to Governor Shelby, in 1796, Boone wrote that

"I first Marked out that Rode in March 1775 and Never rec'd anything for my trubel."

Although at first only a cleared way through the forests, it

sufficed for the great movement of people over this road from 1775 to 1795, since this movement was one on foot. One Kentucky historian says that

"The road marked out was at best a trace. No vehicle of any sort passed over it before it was made a wagon road by action of the State legislature in 1795. The location of the road, however, is a monument to the skill of Boone as a practical engineer and surveyor. It required a mind of far more than ordinary caliber to locate through more than two hundred miles of mountain wilderness a way of travel which, for a hundred years, has remained practically unchanged, and upon which the State has stamped its approval by the expenditure of vast sums of money."

Many roads of vast importance to the advancement of the country followed the Cumberland Road and the Wilderness Road, especially those leading from the Mississippi to the Pacific Coast, as for example, the Oregon Trail, the California Trail, the Sante Fe Trail and the Spanish Trail, which opened up an empire in itself. It was these two roads, however, whose importance cannot be overestimated, that unlocked the door of a treasure chamber whose potential wealth has not to this day been adequately determined nor fully appreciated.

The two most important steps ever taken, affecting roads in the United States, were the laws providing for State aid and Federal aid. Of these two measures, the former still predominates, historically and economically, for it was by the enactment of State aid that statute labor was abolished and financing was placed on a cooperative basis so that all political units of government shared proportionately. Since the State aid provision only falls within the time limits of this study, it alone will be considered.

New Jersey was the first State in the Union to enact a law

providing for State aid when, in 1891, there was created "An Act to provide for the more permanent improvement of the public roads of this State." This law was really conceived, in 1887, at a mass meeting of farmers and others interested in good roads, for as a result of this meeting, there was appointed a committee, consisting of one member for each of the Congressional districts in the State, whose duty it was to study the laws of all states and of foreign countries and to recommend methods for improvement of the road system of the State. The law passed as a result of these studies is partially presented herewith, as follows:

"Whereas public roads in this State have heretofore been built and maintained solely at the expense of the respective townships in which they are located; and

"Whereas such roads are for the convenience of the citizens of the counties in which they are located, and of the entire State as well as of said townships; and

"Whereas the expense of constructing permanently improved roads may be reasonably imposed in due proportions, upon the State and upon the counties in which they are located: Therefore, - - -

"And be it enacted, That whenever there shall be presented to the board of chosen freeholders of any county a petition signed by the owners of at least two-thirds of the lands and real estate fronting or bordering on any public road - - - praying the board to cause such road - - - to be improved under this act, and setting forth that they are willing that the peculiar benefits conferred on the lands fronting or bordering on said road - - - shall be assessed thereon, in amount not exceeding ten per centum of the entire cost of the improvement, it shall be the duty of the board to cause such improvements to be made: Provided, that the estimated cost of all improvements - - in any county in any one year shall not exceed one-half of one per centum of the ratables of such county for the last preceding year - - -

"And be it enacted, That one-third of the cost of all roads constructed - - - shall be paid for out of the State treasury:

Provided, That the amount so paid shall not in any one year exceed the sum of seventy-five thousand dollars. - - "

Massachusetts and Vermont followed with similar acts in 1892,

Connecticut and California in 1895, Maryland and New York in 1898, and the other States in succession.

The story of roads in the United States is in direct contrast to that of Europe. Here were no routes established and in use throughout hundreds of years, only the narrow trails of aborigines and animals; here was no royal power or baronial rule to declare which roads should be improved for military or selfish purpose, but the will of a free people to decide for the benefit of the majority; here was no ecclesiastical authority to encourage road improvements by the promise of absolution from sin, but the desire of all sects and all creeds to better the condition of all men.

The roads of this country are as unique as its form of government, for it was over these roads that there strode a people free in thought, unhampered in movement, with no one to stay the adventurous urge of the individual to carve a new destiny out of a virgin land of almost unlimited resources. Men of all races and creeds and political beliefs, in great variety, traveled these roads, sincere in the belief that their own opinion was worthwhile, yet united by the common bond of respect for the dignity of man, and an unfaltering faith in the Constitution that

"Governments are instituted among Men, deriving their just powers from the consent of the governed."

ROADS OF THE FUTURE

"Here was art undoubtedly - that did not surprise me - all roads, in the ordinary sense, are works of art."

Edgar Allan Poe



1939 - A HIGHWAY MASTERPIECE
Photo by Public Roads Administration

ROADS OF THE FUTURE

Roads today have taken on a complexity in harmony with every other phase of advancement and tomorrow moves into yesterday so rapidly that man's ingenuity must constantly be whetted to a razor edge in order that he may not find himself gaping from the scrap-heap of obsolescence at Science striding over the horizon of an unpredictable future. Until the discovery of steam, transportation was a very simple matter, we traveled at no greater speed and with very little added comfort a century ago than did the people of the Ancient East 5000 years ago. The introduction of the internal combustion engine with its continuous and manifold improvements has so increased the tempo of transportation that at times it even appears incredulous to our blase present-day attitude that almost anything can happen in the realm of the improbable.

The spectacular rise of the railroad in the field of transportation so completely engulfed transportation on roads, that road building sank into a coma from which its most enthusiastic adherents had gloomy forebodings of ever infusing sufficient vitality for it to ever stand upright once more. The astonishing advancement in the automobile industry has so very nearly reversed this picture that we witnessed the unbelievable spectacle of railroads crawling sorrow stricken to the wailing wall, there to bemoan the passing of a glory which was once wholly theirs. Yet, their lacrimose outburst was premature for

never in the history of the world has there existed a greater need for all types of transportation, whether by land or water or air.

How tremendous a factor the motor vehicle has become to our mode of life today is indicated by the fact that in the United States alone registration of motor vehicles of all types has reached the astonishing figure of 30,000,000, of which approximately 25,262,000 are passenger vehicles, including buses and taxicabs, and approximately 4,230,000 are trucks. During the ten-year period alone, from 1928 to 1938, according to L. I. Hewes, the use of highways has increased about 73 per cent. Commercial passenger travel on highways, for example, has grown tremendously in this period. Bus data compiled by 'Bus Transportation' for the full year of 1938 reveal the following with respect to private operations:

Number of Operating Agencies	40,857
Number of Buses Owned	133,300
Miles of Highway Covered	1,614,868
Value of Buses Owned	\$565,000,000
Value of Terminals, Garages, and Equipment	\$213,000,000

Aside from this commercial travel, one of the most important phases of bus transportation is that affecting the field of education, for in this same year, 680,000,000 school children, based on 200 school days per year, in 80,100 school buses, were transported by 36,350 school agencies over a distance of 1,225,000 miles. Educationally, too, may be included the 32,170 rural mail carriers who travel daily over 1,377,000 miles of

roads, the influence of which upon the people of the United States can never be estimated, for the postal service has always, here as elsewhere throughout the world, been dependent upon roads.

High as the present registration of motor vehicles may appear to the casual student of highway transportation, the total registration of all motor vehicles is estimated by the American Petroleum Institute to increase from the present 30,000,000 to 37,000,000 by 1960, with an increase in trucks alone from the present 4,230,000 to 6,000,000. Obviously something, besides political ranting over whose constituents shall be served first and best, must be done to provide adequate and safe highways for these additional millions of vehicles to travel over, other than existing ones now already heavily burdened beyond both capacity and safety.

The life of the ancient highway engineer must have indeed been simple compared with the hectic life of the modern engineer, True, he was concerned with all of the forces of nature, with surmounting tremendous obstacles by means of hand labor alone; yet, the time element, gradient and curvature, excessive speeds and loads, coupled with the present-day maniacal desire to see how fast and how recklessly one can get to a destination for no other reason than to return in the same manner, never entered into the problem of building roads. Neither did cost of construction worry him, causing him to juggle estimates between economical location and political expediency in order to appease local public clamor for a road which later might prove

inexpedient to traffic needs, in the meantime trying to save the taxpayer dollars which he eventually intends to throw away on something less serviceable. Labor was not worth considering for all that was necessary was for the military to conquer a weaker nation or call on the soldiery to keep them out of mischief in time of peace; and route location was a matter of the most direct feasible line, since such problems as property ownership and eminent domain did not exist.

We are faced today, however, with the problem of providing roads adequate to the needs of the future. Great advancement, in both design and method of construction, has been made in the past decade, yet, we are confronted with the paradox of having built roads for the future only to awaken to the fact that many of them will exist for the past. To provide adequate facilities for increased speed and pyramiding traffic volume in both passenger and freight service, two types of roads have been under consideration for some time, and are now either under construction or have already been constructed and tested to satisfaction, namely, the toll highway and the super-highway.

Concerning the toll highway, Pennsylvania has taken the first initial step forward for there is now under construction by the Pennsylvania Turnpike Commission, a modern, express, four-lane divided toll highway extending for 160 miles from Middlesex, 13 miles west of Harrisburg, through the Appalachian Mountains, to Irwin, 15 miles east of Pittsburgh. A preliminary survey was made of this route by the state about one hundred years ago, but the glamour of the railroad swept the humble

road off the stage and the route was partially taken over by the South Penn Railroad, piercing the mountains by eight tunnels. The railroad, however, was abandoned in 1885 after \$10,000,000 had been spent on it.

Financed by a \$26,100,000 grant by the Public Works Administration and a loan of \$35,000,000 from the Reconstruction Finance Corporation, the highway is expected to pay for itself through tolls and become the property of the state. The tolls are estimated to average \$1.25 per through trip for passenger cars and from \$4.00 to \$10.00 for trucks, while for less than full length travel, the toll will vary from one cent per mile for passenger cars to four cents per mile for heavy trucks. Although it seems anomalous that people should be willing to pay toll for the privilege of driving over this highway when several excellent toll-free highways already exist between Eastern and Western Pennsylvania, it is estimated that a saving actually will result to the users of this road. For example, a heavy trailer-truck paying \$10.00 toll will save up to \$27.00 by using this route against alternate routes. Described by adherents as the greatest single highway project in American history, the construction period has been set at twenty months, thereby placing the highway into use for the public by June 29, 1940. One writer has described this road as follows:

"Never before have engineers attempted construction in such a short time of such a long superhighway through a high mountainous region, piercing the towering ridges with tunnels to reduce grades to one-third of existing routes and providing operating conditions equal to those in rolling country.

"The Turnpike is being built over a 200-foot right of way, graded 78 feet wide in the open but reducing to 28

feet in the seven tunnels. There will be four 12-foot traffic lanes, separated in the center by a 10-foot strip. On fills there will be two 10-foot berms or shoulders; in cuts the berms will be 7 feet with 3-foot drainage ditches. In the tunnels there will be two 11½-foot traffic lanes.

"All cities and towns along the route will be by-passed. There will be no intersecting crossroads or railroad grade crossings - no stopping for traffic lights. The maximum ascending grade will be 3 per cent; curves will be long and sweeping with a minimum radius of 6 degrees or about 955 feet. Cloverleaf type of intersections will be built at the various points of exit and entrance. There will be third lanes for acceleration and deceleration leading into and off the road. The Turnpike will underpass 32 and overpass 49 state roads along the line."

Germany, as a nation, has been the pioneer in super-highway construction. As Carpenter, in 'Highways of Germany', expresses it,

"The new motor roads constructed and being constructed in Germany should prove a sense of inspiration to highway engineers throughout the world. When the present program is completed, Germany will have a vast network of good roads connecting all principal towns and her borders.

"The Seventh International Road-Building Congress in 1934 adopted an official resolution recognizing the planning and building of the German network of motor highways as a model of their kind, and there can be but little doubt that neighboring countries will endeavor to build similar roads so that eventually all Europe will be a network of superhighways."

The horrible spectre of War, however, has stalked again into the daily life of Europe so that the highways of Europe, instead of echoing to the purr of commercial enterprise and the laughter of pleasure-seeking vacationists, now crackles to the sound of rumbling mechanized armies, intent on obliterating civilization. Destruction and not construction has taken the leading role, and these superhighways have assumed major proportions in transporting troops with a rapidity never even dreamed of by the great military strategists and tacticians

of history.

A comparative study between the new Reich motor road from Burchsal to Bad Nauheim, 91.14 miles, and the parallel old Reich Highway No. 3, 99.82 miles, reveals, according to Carpenter, that

"The old route passes through three large cities and thirty-two towns and villages (comprising 38 per cent of the total distance) while the new Reich motor road does not go through any towns. The old highway, too, has one hundred and thirty-six grade crossings against none on the new route. In a distance of 62 miles, there are eight branch roads which give access to or egress from the Reich motor road, while the old highway has no less than 463 branch or intersecting roads with a consequent heavily increased accident hazard because these branch roads are not designed to give the high degree of safety as are the connecting roads to the Reich motor road which lead into it and necessitate no turning of corners or crossing against traffic.

"The survey also clearly shows that other hazards are removed altogether on the Reich motor roads for there is a double track or two-way roadway which obviates the necessity of passing cars proceeding in the opposite direction, whereas on the old highway, statistics indicate there is an average of 218 motor cars which had to be met and passed in 62 miles of road.

"On the new Reich motor roads, cars can be safely operated at 93 per cent of their maximum speed whereas on the old road about 56 per cent has been estimated as the limit for safety. It was also estimated that cars operating on the new road consumed 42 per cent less fuel than would be necessary on the old road as on test runs a car on the new highway was not steered out of its course while the car on the old road had to be diverted from a straight course no less than 570 times in traveling the same distance. Other tests indicated a 99 per cent saving of brakes and a reduction of strain on springs on cars using the new highway. The analysis of this test, of course, applies equally to other stretches of the new Reich motor roads."

With regard to the construction details of these German superhighways, this same writer describes them as follows:

"Insofar as possible the technical construction of all the new roads has been designed to blend in with the natural beauties of the landscape. The actual road surfaces are perfectly smooth and are of light-colored

concrete bound by dark, raised strips of asphalt or tar macadam. Minimum radius for horizontal curves in level country is 5,890 feet, and for hilly country is 2,620 feet. While perfect visibility is provided, roads are sufficiently curved to avoid the monotony and tiring effect which could be created by long stretches of straight highway.

"Dividing the double 24 $\frac{1}{2}$ -foot roadway is a 16 $\frac{1}{2}$ -inch wide strip of grass or plants. Short crossways connect the two roadways at certain locations, each crossway being for one-way traffic only. Crossing with other highways and railways is always done either overhead or underneath. Specially designed side roads or spurs lead to all inhabited areas, so that traffic on the main highway is not interrupted by passing through any towns or villages.

"The Reich motor roads when completed will provide three great routes in Germany from west to east and two from north to south which more or less follow the ancient trade routes from the North and the Baltic Seas to the Mediterranean, and from the countries of Western Europe to the Orient. Approximately 1,330 miles of superhighways have already been constructed. Besides, some 25,000 miles of existing highways are being repaired, widened, graded, etc."

The road mileage in the United States is on such a vast scale, consisting of approximately 330,000 miles of primary roads under the Federal and State Systems and approximately 2,700,000 miles of secondary roads, that a tremendous volume of work is entailed in compiling complete data from which to formulate plans for an efficient and economical superhighway program, however studies conducted in all forty-eight states, known as Highway Planning Surveys, are sufficiently advanced so that the Public Roads Administration has been able to make a study of the need for superhighways on a national scale and prepare a comprehensive report on the subject. Kettering, in his paper entitled 'Joint Responsibility of the Automotive and the Civil Engineer', estimates that a primary system of from 50,000 to 60,000 miles of superhighways, crossing the country

in all directions, will be necessary to provide facilities for the 1960 increase in motor vehicle registrations. However, the special report prepared by the Public Roads Administration recommends a plan whereby it is proposed to create a national system of interregional highways, approximately 27,000 miles in extent, by modernizing and improving existing routes of travel and building new roads where necessary to provide more direct travel. In addition to this system of interregional highways, the master plan, accompanying the report, included construction of express highways through cities, belt-line distribution routes around them, and by-passes around small towns. In his message to Congress, with respect to this report, President Roosevelt brought out that,

"It shows that there is need of super-highways, but it makes it clear that this need exists only where there is congestion on the existing roads, and mainly in metropolitan areas."

Considerable criticism has been directed at the highway engineer for his apparent delinquency in not providing roads to serve future needs, but these critics fail to take into consideration two very important factors; their own unwillingness to assume the increased cost of these improvements and the rapid advancement in perfection of the motor vehicle. As so aptly stated by Kettering of General Motors Corporation, criticism of this nature is hardly fair when even the automotive engineer is unable to predict what the next step forward in motor vehicle design will be or when it will occur. While it is quite feasible for the individual to trade in last year's car for a newer model, it is quite impossible for the highway

engineer to change the model of his road every few years to satisfy the carping of these same individuals who will refuse to meet the issue when they are faced with the cost. As for the automobile itself, no difficulty will ever be encountered in determining adequate design of highways, it is the man behind the wheel who must be safeguarded as much as is humanly possible against his own recklessness.

REFERENCES

- | | |
|--|---|
| Agg, T. R. & Brindley, J. E. | Highway Administration and Finance |
| Aitken, Thomas | Road Making and Maintenance |
| Ashby, Thomas | The Roman Campagna in Classical Times |
| Baikie, James | Sea Kings of Crete
The Ancient East and Its Story
Egyptian Antiquities in the Nile Valley
The Life of the Ancient East
The Glamour of the Near East
Excavations
The Story of the Pharaohs |
| Banks, E. J. | The Seven Wonders of the Ancient World |
| Babylonian, Armenian and Assyrian Literature | Translation |
| Belloc, Hilaire | The Old Road |
| Benjamin, S. G. W. | The Story of Persia |
| Bertholet, Alfred | A History of Jewish Civilization |
| Bible, The Holy | |
| Bingham, Hiram | Inca Land |
| Black, Archibald | The Story of Tunnels |
| Blanchard, A. H. & Drowne, H. B. | Textbook on Highway Engineering |
| Blom, Frans | Commerce, Trade and Monetary Units of the Maya |
| Boissonnade, P. | Life and Work in Medieval Europe |
| Breasted, J. H. | The Conquest of Civilization
A History of the Ancient Egyptians |

Bridge, J. S. C.	A History of France
Brugsch, Heinrich	Egypt under the Pharaohs
Budge, E. A . W.	The Dwellers of the Nile A Short History of the Egyptian People Babylonian Life and History
Burgh, W. G. de	Legacy of the Ancient World
Burns, A. R.	Minoans, Philistines and Greeks
Bury, J. B.	History of the Late Roman Empire
Buxton, L. H. D.	China - The Land and the People
Carleton, Patrick	Buried Empires
Carpenter, F. S.	China
Cary, M. & Warmington, E. H.	The Ancient Explorers
Castillo, Bernal Diaz del	The True History of the Con- quest of Mexico
Chapot, Victor	The Roman World
Charlesworth, M. P.	Trade Routes and Commerce of the Roman Empire
Charnay, Desire	Ancient Cities of the New World
Chatburn, G. R.	Highways and Highway Trans- portation
Chiera, Edward	They Wrote on Clay
Childe, V. G.	New Light on the Most Ancient East
Clark, E. L.	Israel in Egypt
Clavijo	Embassy to Tamerlane
Confucius	The Analects
Creel, George	The People Next Door
Creel, H. G.	The Birth of China

Davis, E. C.	Ancient Americans
Davis, H. W. C.	Charlemagne
Delaporte, L.	Mesopotamia - The Babylonian and Assyrian Civilization
Dopsch, Alfons	The Economic and Social Foundations of European Civilization
Dupin, F. P. C.	The Commercial Power of Great Britain
Durant, Will	The Story of Civilization
Durrenberger, J. A.	Turnpikes
Earle, A. M.	Stage Coach and Tavern Days
Enders, E. C.	Swinging Lanterns
Engelbach, R.	The Problem of the Obelisks
Erskine, Mrs. Stewart	The Vanished Cities of Arabia The Vanished Cities of North Africa
Faris, J. T.	Roaming American Highways Old Roads out of Philadelphia
Filmer, Henry	The Pageant of Persia
Fleming, A. P. M. & Brocklehurst, H. J.	A History of Engineering
Fox, Ralph	Genghis Khan
Friedlander, Ludwig	Roman Life and Manners
Gadd, C. J.	History and Monuments of Ur
Geil, W. E.	Eighteen Capitals of China
Glötz, Gustave	The AEgean Civilization
Gosse, A. B.	The Civilization of Ancient Egypt
Gowen, H. H.	An Outline History of China
Grant, G. P.	The Syrian Desert

Granet, Marcel	Chinese Civilization
Gregory, J. W.	The Story of the Road
Handcock, P. S. P.	Mesopotamian Archaeology
Haskins, C. H.	Studies in Medieval Culture
Hawks, Ellison	The Romance of Transport
Hayes, C. J. H.	A Political and Cultural History of Modern Europe
Hedin, Sven	The Silk Road Jehol, City of Emperors
Herodotus	
Hewett, E. L.	Ancient Life in Mexico and Central America
Hilprecht, H. V.	Explorations in Bible Lands
Homer	
Huart, Clement	Ancient Persia and Iranian Civilizations
Hulbert, A. B.	The Old National Road Historic Highways of America Paths of Inland Commerce
Jastrow, M. Jr.	The Civilization of Baby- lonia and Assyria
Johnson, Amanda	Georgia - As a Colony and State
Josephus	Jewish Antiquities
King, L. W.	History of Babylon A History of Sumer and Akkad
Kirby, R. S. & Laurson, P. G.	The Early Years of Modern Civil Engineering
Koldewey, Robert	The Excavations at Babylon
Krynine, D. P.	Text Book on Highway Engi- neering
Layard, A. H.	Babylon and Nineveh
Lenormant & Chevallier	Ancient History of the East

Lepsius, K. R.	Letters from Egypt
Lucretius	
Ludwig, Emil	Napoleon
Macalister, R. A. S .	A Century of Excavation in Palestine
MacDonald, T. H.	Development of Road Building in the United States
MacGowen, J.	The Imperial History of China
Macurdy, G. H.	Troy and Paeonia
Madison, James	Collected Writings
Mariette, Auguste	The Monuments of Upper Egypt
Maspero, Gaston	The Story of Nations - Egypt, Syria and Assyria Life in Ancient Egypt and Assyria Dawn of Civilization Popular Stories of Ancient Egypt
Means, P. A.	Ancient Civilizations of the Andes
Meyers, Balshaser	History of Transportation in the United States before 1860
Miller, J. A.	Master Builders of Sixty Centuries
Miller, S. L.	Inland Transportation
Mills, Dorothy	The Middle Ages
Mitman, C. W.	An Outline Development of Highway Travel, Especially in America
Monroe, James	Collected Writings
Moore, F. G.	The Roman's World
Moret, Alexander	The Nile and Egyptian Civilization
Morris, Charles	Japan and China

Moss, H. St.L. B.	The Birth of the Middle Ages
Newton, A. P.	Travel and Travelers in the Middle Ages
Olmstead, A. T.	History of Assyria History of Palestine and Syria
Page, L. W.	Roads, Paths and Bridges
Parker, E. H.	A Thousand Years of the Tartars
Parkes, Joan	Travel in England in the 17th Century
Pate, J. E.	Highway Administration in the South
Pausanias	Description of Greece
Petrie, W. M. F.	Social Life in Ancient Egypt A History of Egypt
Pliny	
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